MODERN PLASTICS

FEBRUARY 1955

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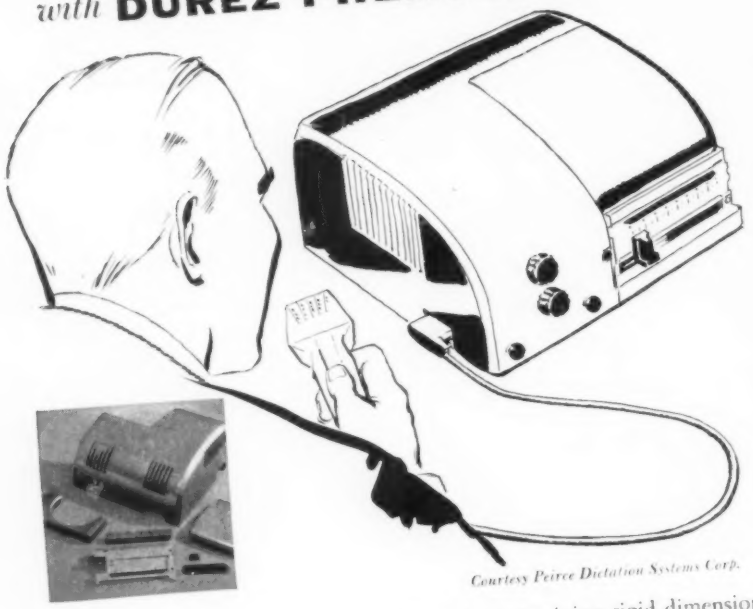
Another up-to-date product gets . . .

TALKING POINTS *and* SAVINGS *with* DUREZ PHENOLICS



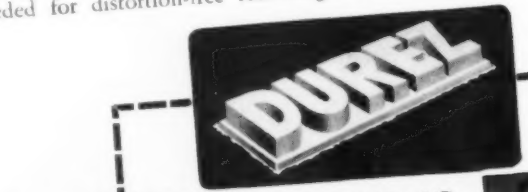
Courtesy Peirce Dictation Systems Corp.

These materials offer you a fruitful approach to savings on the production line as well as buyer benefits for your products. Either result is profitable... both are doubly so.

For example, a major part of finishing cost on this new Peirce Magnetic Belt Dictation unit was saved by using Durez for the five-piece molded case and dial panel. The desired color and quality of finish is applied by a low-cost process that would have been impossible on metal parts. Being self-insulating, the material prevents shorts in units. In two belt drum parts it also contributes to constant signal output needed for distortion-free recording. Ease in maintaining rigid dimensional tolerances and ability to mold-in slots, holes, and threaded inserts also helped to hold cost down.

Whether or not you are already using plastics, it will pay you to inquire into the phenolics today. Interesting new developments by Durez are extending the industrial importance of these highly versatile materials.

Call on our 34 years of specialized experience for help in solving your materials problems. You'll find interesting reports in our illustrated monthly "Plastics News." Write Durez Plastics & Chemicals, Inc., 1202 Walck Road, North Tonawanda, New York.



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Catalin **HIGH IMPACT** *Styrene*

Knickerbocker Penny Banks, Pull Toys and Novelties *play right into the hands* of little people . . . And, because this means constant cuddling, handling, pulling and tugging, each is made to withstand over-ardent affection. Of the plastic materials, CATALIN *High-Impact Styrene* proved to be the one best qualified. It is toy-colorful, light in weight, structurally rugged and cost-favorable. Its smooth surface is adaptable to spray finishing. Note the effective paint-contrasts achieved in *dressing-up* Father and Mother Rabbit. We at CATALIN are inclined to crow with the Knickerbocker Rooster for having contributed *materially* to the success enjoyed by these outstanding Eastertime attractions.

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CATALIN

In addition to Styrene Molding Compounds, Catalin chemical products include a wide range of Urea, Phenolic, Cresylic, Resorcinol, Melamine and Styrene Resin formulations

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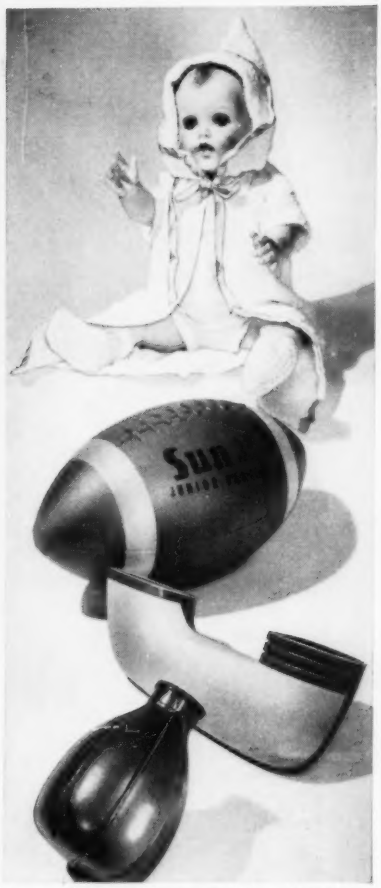
B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Company does not make the machine or any of the products shown.

Geon stars in continuous molding process

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There's a whole family of Geon polyvinyl materials that make sales-successes from dolls to upholstery, rust-and-acid-proof rigid piping, and top grade electrical insulation. Helpful technical information is yours for the asking. Please write Dept. BR-2, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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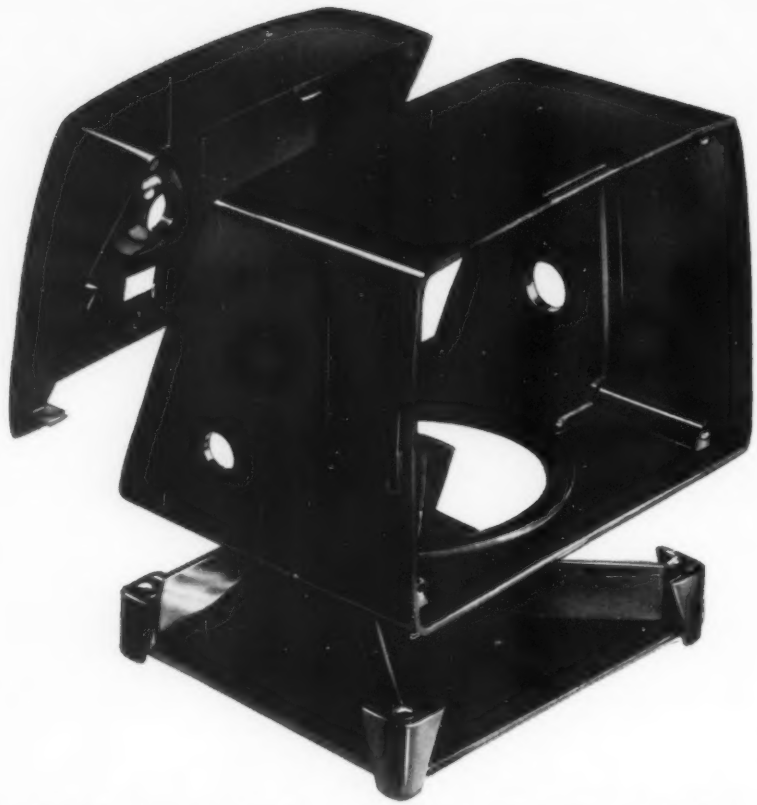
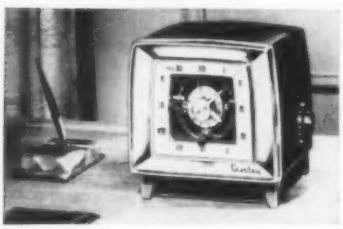
GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors



WE WORKED THIS ONE OUT FOR CROSLEY

. . . is your problem any tougher?



According to Crosley, "V.I.P." means "Very Important Product" for "Very Important People." It also means "Very Intricate Production."

The plastic housing of the new Crosley "V.I.P." clock radio is made of three matching parts. As you can see, they have undercuts, flanges, bosses, slots and side openings. And since the three sections have to fit snugly together, all these design features have to be molded to close tolerances.

Crosley rated the job a tough one . . . and called in Chicago Molded.

It took an opposed plunger mold to produce the main housing. Large movable cores were used for the control and speaker openings. Even the base offered a challenge — it's a partitioned, three-way chamber that fans the sound out the front and both sides.

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EDITORIAL

Emphasis on Construction

While total building activity in the United States in 1954 represents an increase of approximately 4% over 1953, the total consumption of plastics by the building trades showed a 20% increase—that total amounting to well over 400 million pounds. This, in spite of major stymies in building codes, craft inertia, and fear of materials innovations on the part of many builders and architects.

According to the best projections of the F. W. Dodge Corporation, construction marketing specialists, the 1955 building market in terms of dollars will surpass last year by 6% to make for a total of something over $38,000,000,000. Now, half a billion dollars for the plastics industry is not a very big share of this tremendous and continuing market. If the plastics industry is to enjoy a worthier portion of this market, a planned and co-ordinated program of engineering research and promotion must be created.

The industry was most pleasantly surprised at the enthusiasm engendered and the scope of information presented at the "Plastics in Building" Conference in Washington in November. Executives in the building field were also pleasantly surprised. The interest in plastics is there; so is a definite need for the increased use of plastics in building.

Our present issue emphasizes several facets of this proposition and a study of the lead feature will indicate a pattern for further effort by the makers and processors of plastic materials as well as by architects and builders.

It is generally recognized that the most tradition-breaking designs in building in recent years have been in the area of school construction. Here plastics have made their greatest progress, chiefly because they protect while transmitting light, they stand up to abuse, and they are easy to maintain. With an almost algebraic progression in population increase assisted by a high level of personal income, there will be a continuing requirement for new school facilities and a greater opportunity for the use of plastics in school buildings.

A second main area of opportunity is in prefabrication designed to reduce site labor, particularly in small home construction. Here plastics lend themselves to the production of structural, load-bearing panels with integral decoration and insulation.

A third area is separate from the formal field of building: it is the do-it-yourself market where plastics have gained great new ground in recent years.

There is a promotional relationship between this do-it-yourself market and the professional building market occasioned by public acceptance of and respect for plastics. Formal specification of plastics by architects and building authorities, more generous appreciation of plastics at the conservative code-making level, will come through public pressure.

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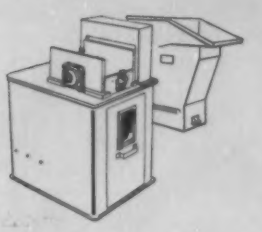
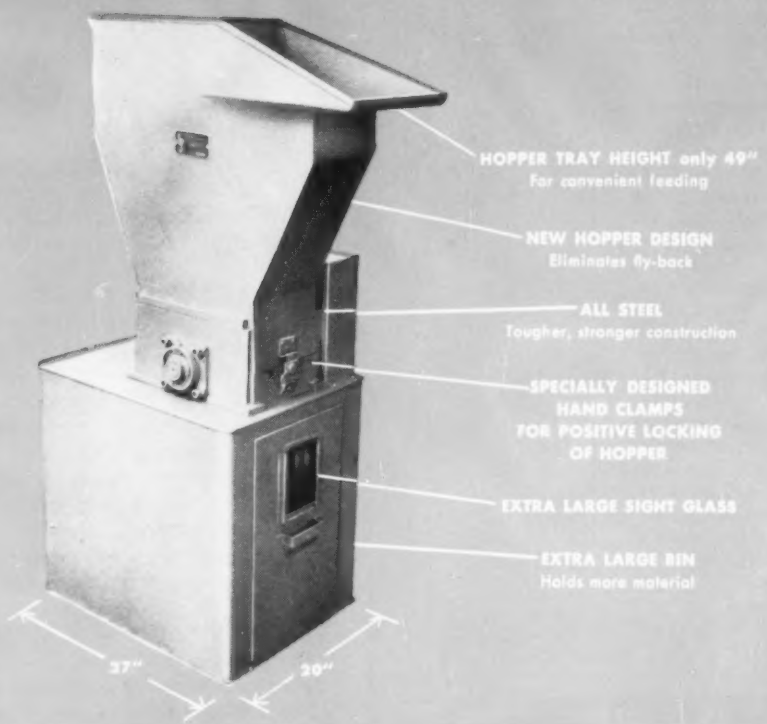


Large 8"x8" throat opening accommodates rejects as well as sprues and runners.



outperforms any beside-the-press grinder of comparable size and cost

Never before have you been able to get such outstanding performance from a grinder that costs so little. The new B&J M-100 is ideally suited for beside-the-press grinding, and, with its capacity up to 200 pounds hourly, can also be used as a batch grinder. It grinds all plastics, including elastomerics such as *polyethylene*, without fluffing. Double shear knife action readily cuts hard or soft plastics – hot and cold sprues can be fed simultaneously.

The M-100 is simpler to maintain, simpler to operate, simpler to clean than any machine on the market. Completely enclosed, it stays clean longer. The extra large sight glass shows operator when bin is filled. The extra large bin holds more, slips in and out with ease.

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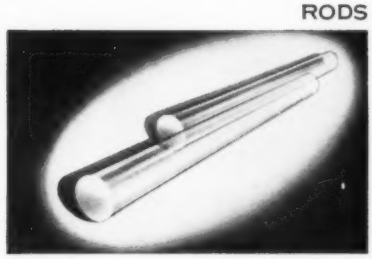
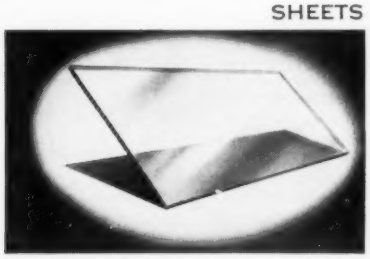
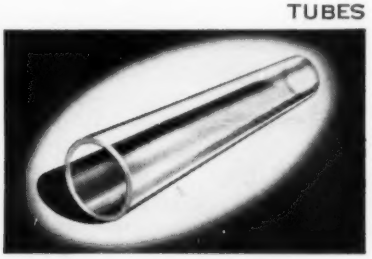


SHEETS



TUBES



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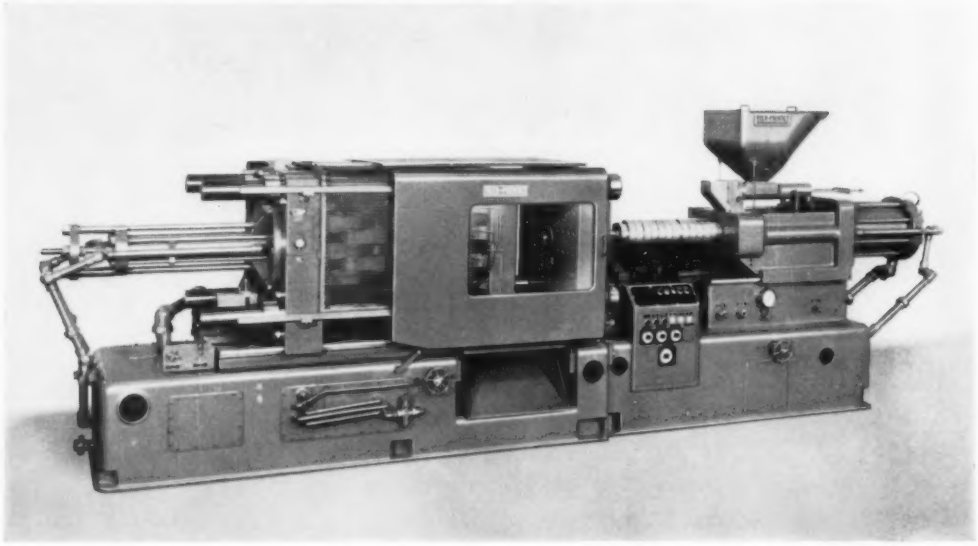
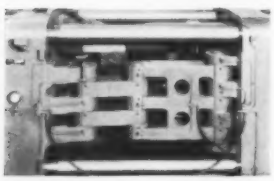


extra molding capacity through multiple strokes



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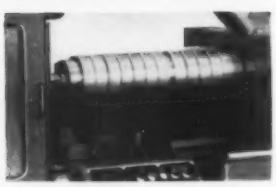

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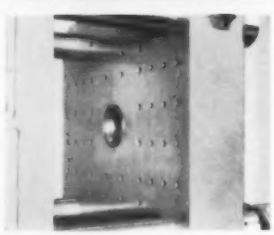

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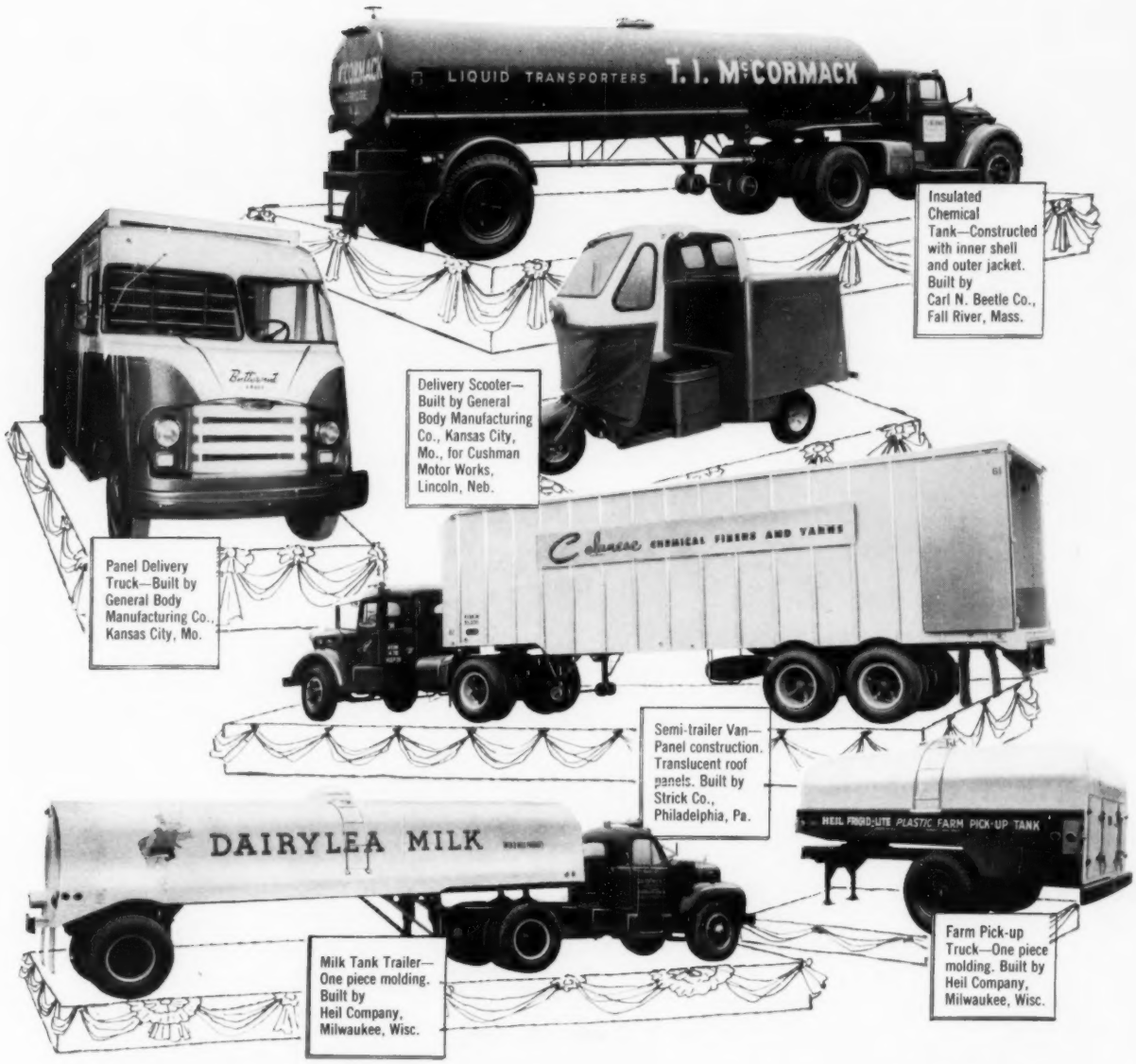
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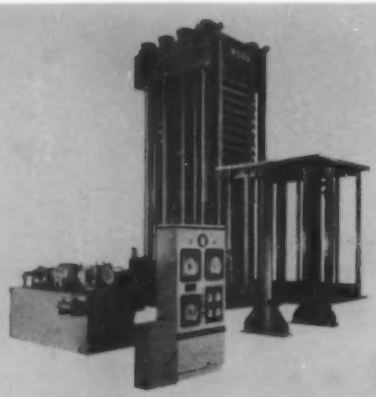
Celanese* PLASTICS and RESINS



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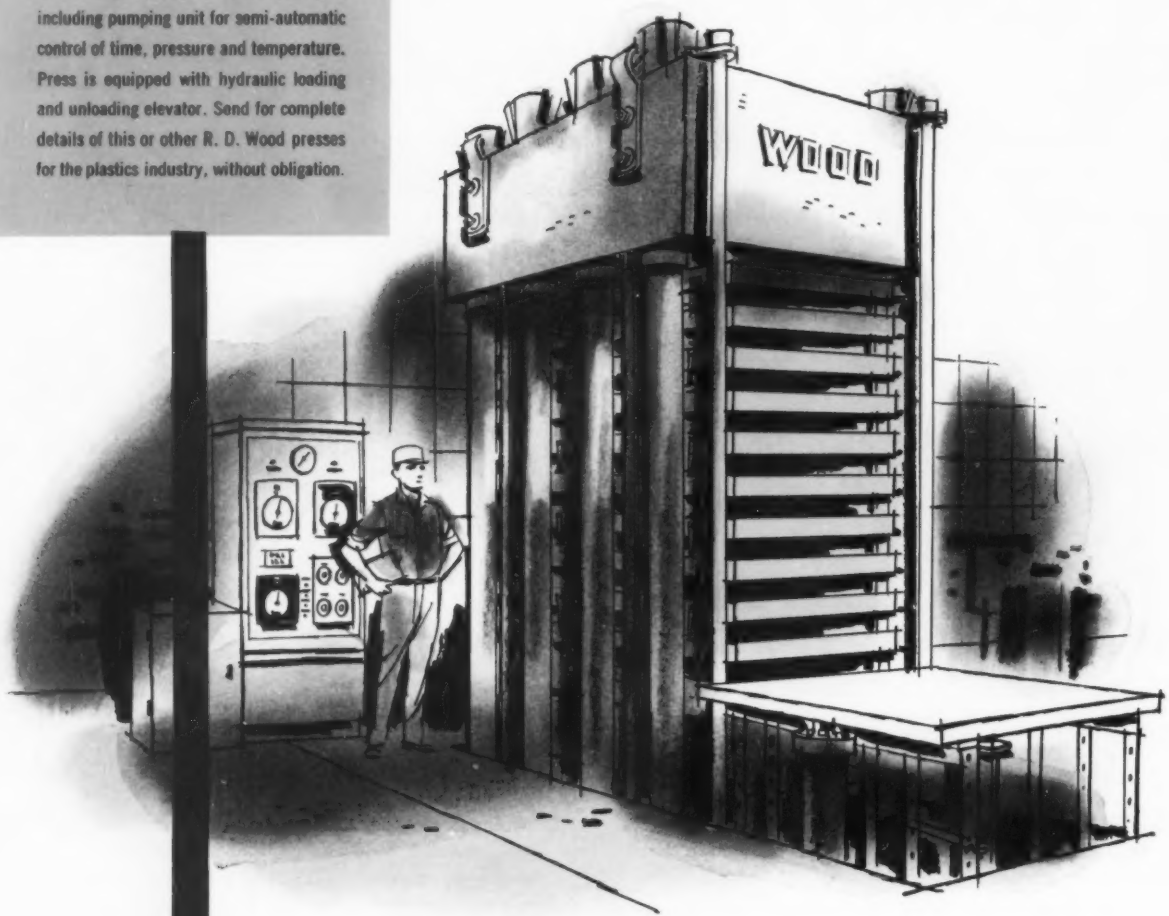

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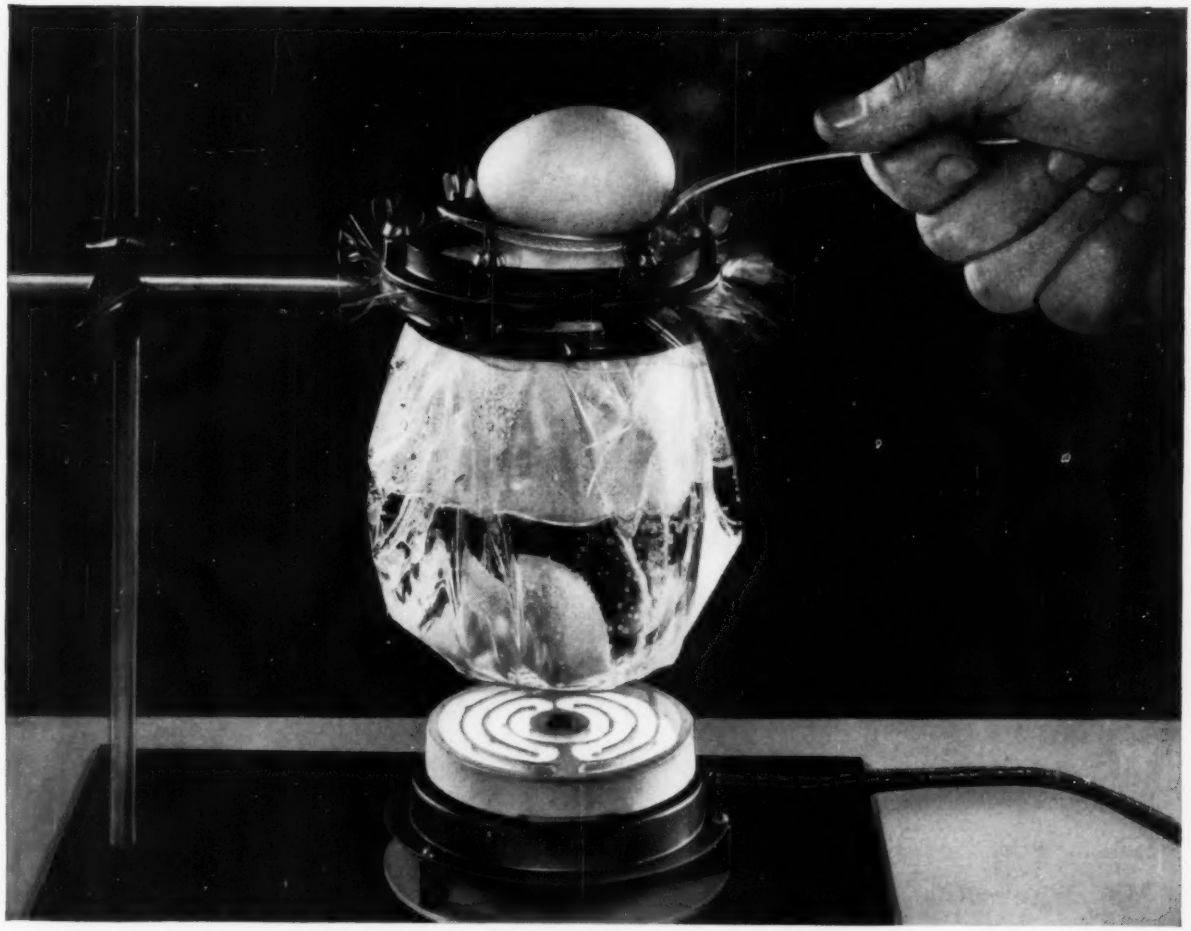
STARTLING...the heat resistance of this new plastic film



CHALLENGING to industry...the combination of remarkable properties offered by Du Pont MYLAR*

The amazing stability at extremes of heat and cold is just one of the properties of "Mylar" polyester film that may help you improve a product.

"Mylar" is also the strongest plastic film available.

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Its outstanding dielectric strength makes it an ideal insulating material.

Its resistance to moisture and many solvents further increases its range of applications. Laminated to other plastics, to metal foils or papers, it makes vapor barriers . . . decorative and protective laminates.

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Wilmington 98, Delaware

Please send me sample and further information on "Mylar" Polyester Film.

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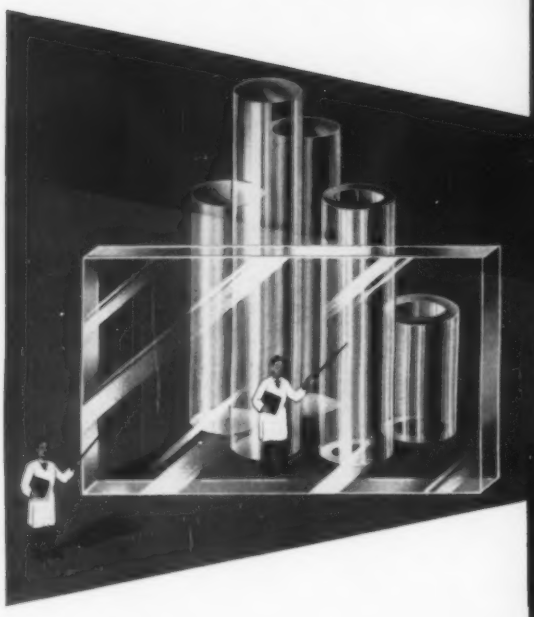

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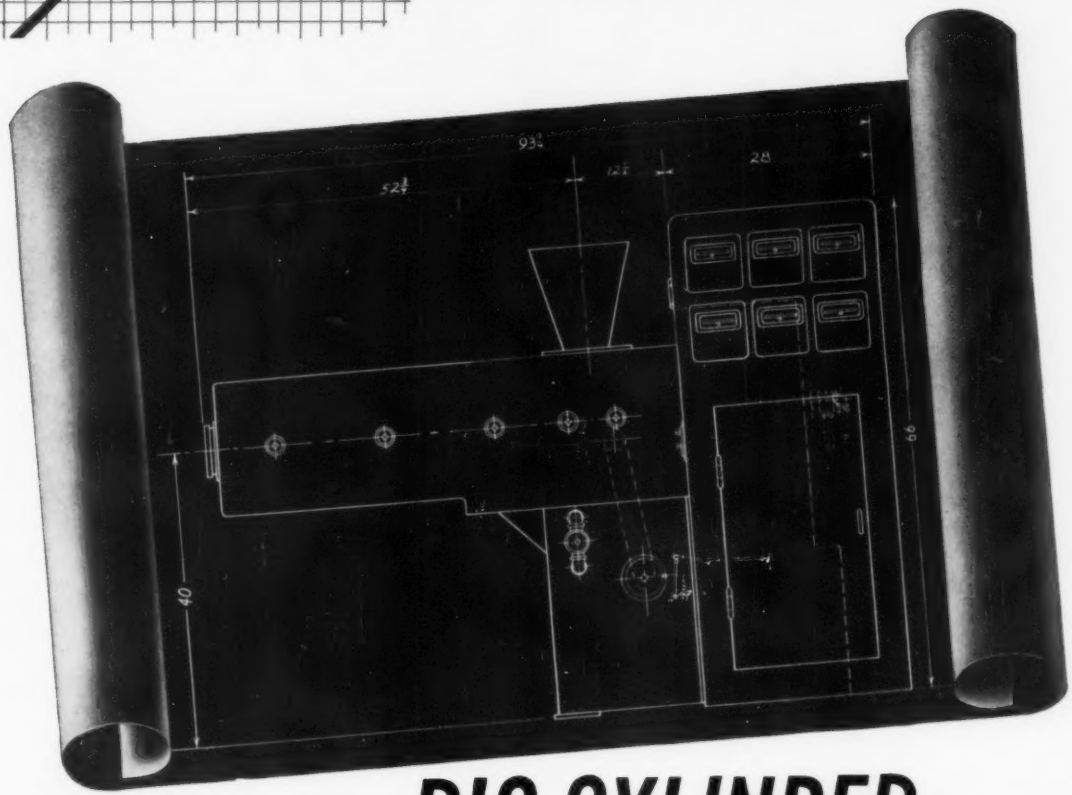
~~INCREASE~~ production and efficiency



with this new *BIG CYLINDER* extruder

• More than a draftsman's dream, this new MPM 3½" Extruder is off the drawing board and ready to dictate bigger and more efficient production. Increased production requirements demanded extruders with larger working screw lengths . . . and MPM answered with a series of machines built with screws 16 times bore diameter. This greater working area means new speed and uniformity in the extrusion of film and rod . . . it provides more thorough mixing, more uniform heating.

The unit, also available in 1½", 2½", 4½", and 6" models, is supplied with either a motor generator set or mechanical speed variable reduction drive, depending upon speeds needed. The cylinder and liner are both of one-piece forging, and along with the hopper and screw, are constructed of corrosion-resistant stainless steel. Temperatures are regulated by 6 cylinder and die control zones, plus 9 cooling sections. Special MPM Electronic Heat Controllers can be installed to provide the most accurate, stepless temperature regulation available.

If you're seeking higher extrusion output plus a better blend of ingredients, inquire now about this new MPM unit. You can get a variety of sizes, and each unit can be fitted with different screws to handle different thermoplastics. Get complete details now by writing: Modern Plastic Machinery Corp., 15 Union Street, Lodi, N. J.

mpm
modern plastic machinery corp.
15 Union St., Lodi, N. J.
cable address: MODPLASEX

West Coast Representative
4113 West Jefferson St., Los Angeles 16, Calif.

IMPELLING REASON

for molding precision parts of PLIOVIC

Heart of a problem for manufacturers of a unique, positive displacement, rotary pump was its elastomeric impeller. In trial units its volume increased some 2%, through absorption of water. High operating pressures plus frictional heat caused further dimensional expansion. As a result, the pump, precision-made to clearances of 0.002″ to 0.003″, often became inoperative.

In an attempt to free the situation, the all-nitrile-rubber compound was abandoned. New compounds based on polyvinyl chloride resins were tried. After many tests with many resins, it was found that PLIOVIC—the easy processing vinyl—when plasticized with the original rubber, gave the lowest water absorption—0.1% or less. Extensive field trials then proved the PLIOVIC rubber impeller was extremely smooth-working and virtually indestructible.

Moreover, production workers found that high density PLIOVIC was easier handled, blended more rapidly and thoroughly with the rubber and gave consistently faithful reproduction of the mold. The sum total was a finer product at a cost lower than that possible with other resins.

The particular PLIOVIC used in the impeller compound is one of a family designed to help you to new or improved products, easily and economically. Each of these resins is carefully controlled as to its particle size, shape and distribution to give you maximum ease of processing without sacrifice of desired physical properties. For details, samples and full technical help on which PLIOVIC is best suited to your needs, just write to: Goodyear, Chemical Division, Akron 16, Ohio.

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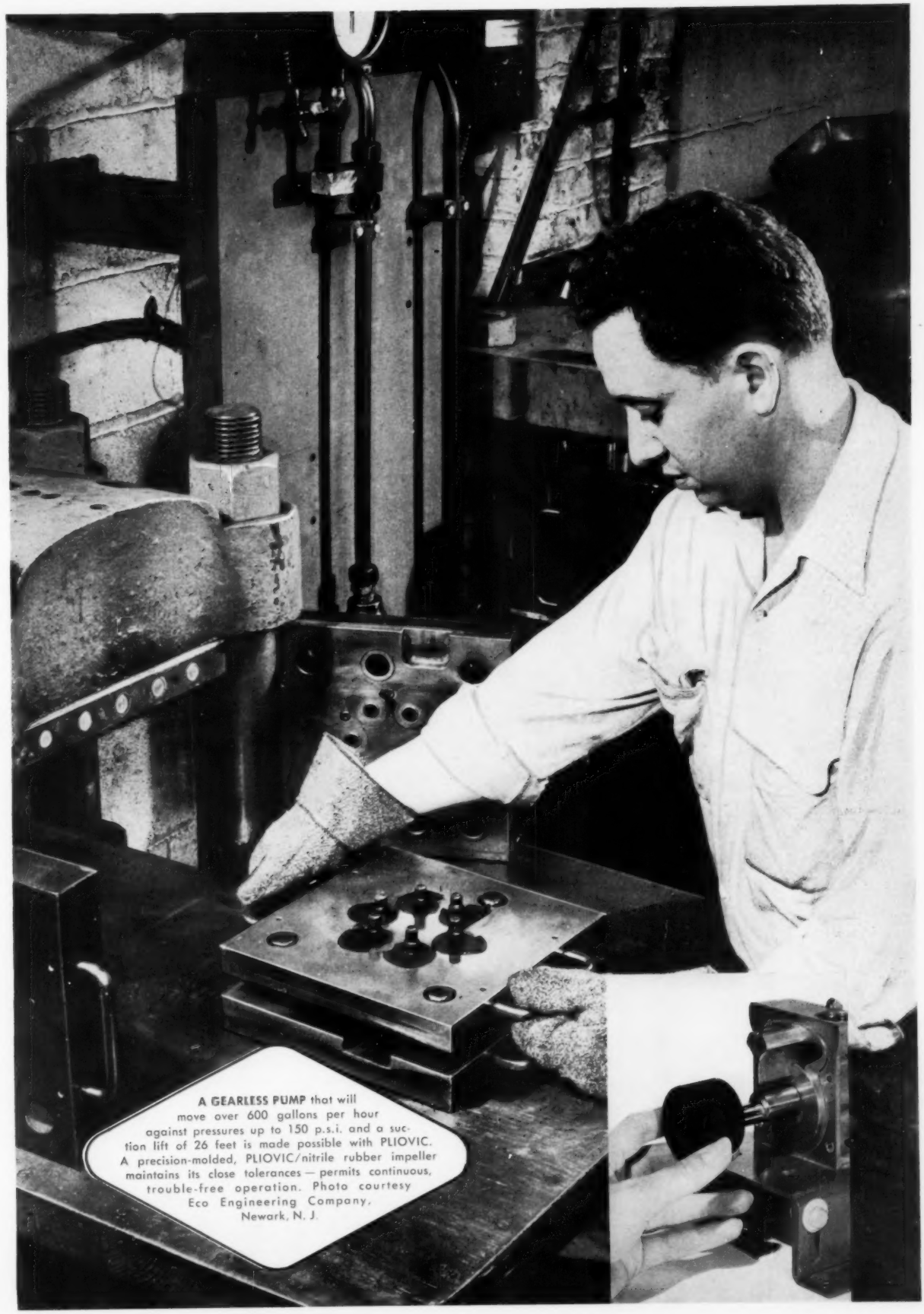
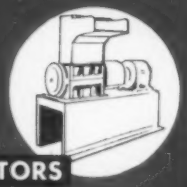
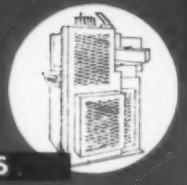


A GEARLESS PUMP that will move over 600 gallons per hour against pressures up to 150 p.s.i. and a suction lift of 26 feet is made possible with PLIOVIC. A precision-molded, PLIOVIC/nitrile rubber impeller maintains its close tolerances — permits continuous, trouble-free operation. Photo courtesy Eco Engineering Company, Newark, N. J.

In Plastics Reducing Machinery, Look to CUMBERLAND for the COMPLETE LINE

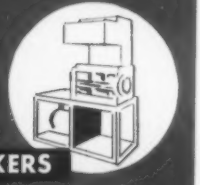


GRANULATORS



DICERS

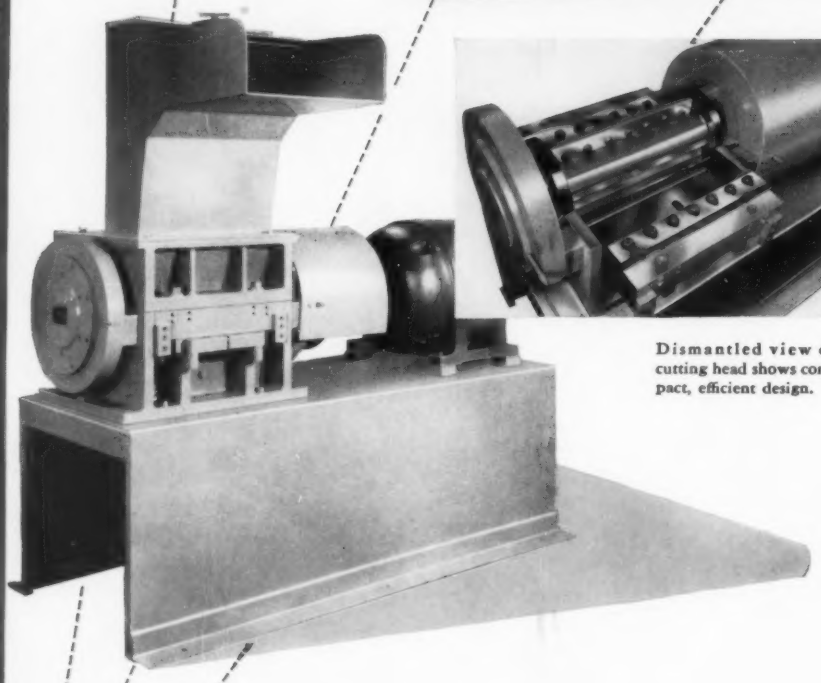
CHOPPERS



PREBREAKERS

MODEL 20 All Steel Granulator

CUSTOM ENGINEERED QUALITY BUILT



Dismantled view of cutting head shows compact, efficient design.

1 HEAVY DUTY — Large flywheel—thick all-steel weldments—deep welds—parts are of flawless wrought steel (not steel castings)—machine resists wreckage.

2 LARGE THROAT OPENING — 8 by 20″ size.

3 PRIOR BANDSAWING NOT NEEDED — Machine specially built to handle large chunky parts such as bleeder scrap, cylinder purgings and heavy cast slabs of polystyrene, modified polystyrene and acrylic resins.

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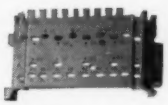
Are you satisfied with your moulded plastic parts?

Does your part have to fly in the air?  and stand extreme temperature changes without cracking? Or is it buried in the ground--- subject to alkalies and impact? Does it have water on the inside and air on the outside? Contain steam? Or pass radar impulses? An electronic insulator? Pump sand or liquids? Or is it a bearing operating in acid? Or is it a "simple" knob that just isn't supposed to fall off?

If your problem isn't just price, but making your plastic parts perform a TROUBLE-FREE function in the field,--and in a way that does your brand-name proud--chances are we can be of some help to you. Others have found it so.Give us a try.

We specialize exclusively in plunger, transfer, and compression mouldings of all thermosettings plastics, glass reinforced moulding compounds and fluorocarbons. And we're ready for your job now!

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Vickers-Detroit hydraulic equipment

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***EARLY DELIVERY**

SPECIFICATION

Approximate weight of material plasticized per hour (Dependent upon weight per shot and material used)	22 lb.
Area of Injection plunger	2·074 sq. in.
Pressure per square inch on material at end of plunger	9,100 lb.
Total pressure on Injection plunger	18,850 lb.
Mold opens (adjustable)	6—9 in.
Maximum die space	7¼ in.
Minimum die space	3½ in.
Maximum recommended casting area in mold	15 sq. in.
Size of die plates	16 x 10 in.

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The wing tips of this Thunderstreak jet fighter-bomber are of Fiberglas*-Reinforced Plastics . . . also the radome . . . fuel cell support liners . . . exterior ice shields . . . even the engine blades! And soon—Fiberglas-Reinforced Plastics for armor that resists gun fire and shell fragments . . . as well as for primary structural members in guided missiles. And this is only the beginning!

What's *your* line? Planes? Perambulators? Plows? Whatever your product, you might make it better, safer or at lower cost by molding it of Fiberglas-Reinforced Plastics. Look into these fast growing materials now. For further information, please write: Owens-Corning Fiberglas Corporation, Plastics Reinforcement Division, 598 Madison Ave., New York 22, N. Y.

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*T. M. Reg. O-CF Corp

Elephant's weight fails to damage new lightweight foamed plastic

BLOCKS of Koppers Expandable Polystyrene, so light that a child can toss them with ease, carried the bone crushing weight of this elephant. These blocks weighed less than 1.5 pounds each, yet were undamaged by this tremendous weight.

Products made with Koppers Expandable Polystyrene contain millions of tiny plastic cells forming a light, tough network. Koppers supplies this new plastic in the form of high density, sugar-sized granules. You simply pour them in a mold (any shape you want), apply heat and they puff up to fill the entire cavity. Open the mold and you have a lightweight article made in the shape and strength you want.

This new polystyrene foam is just the thing for insulation, packaging, flotation members, toys, displays, sandwich panel constructions, and many other applications.

Koppers Expandable Polystyrene is the *right* choice whenever you need a material that is light weight and has smooth paintable surfaces, high strength and precisely molded features. For more information write for a copy of our illustrated booklet.

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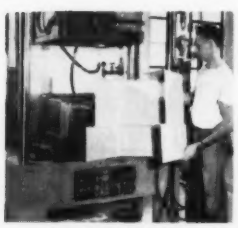
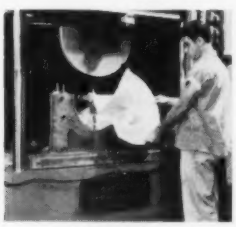
From flat sheet stock to deep draw washing machine tubs, an H-P-M is built for the job! With plenty of daylight and stroke, each press is equipped for semi-automatic operation, fast closing, automatic slowdowns and accurate control of speed and pressures necessary in the molding of reinforced plastic parts.



Air Conditioning

Yes, H-P-M presses have made a name for themselves in the reinforced plastic industry. Shown pictorially are a few industries using reinforced plastics moldings and H-P-M presses. And, there are a multitude of new markets opening up for the molder who is equipped to mold reinforced plastics on a production basis.



Aircraft

Write today for complete data on this line of *stock presses and take advantage of the growing market with H-P-M Presses.

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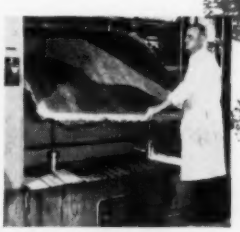

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Peerless Roll Leaf Company has marked practically every type of plastic . . . has made equipment for marking most every size and shape of plastic product . . . and continues to be first in their field with new advancements in plastics marking, and the manufacture of plastics marking machinery.

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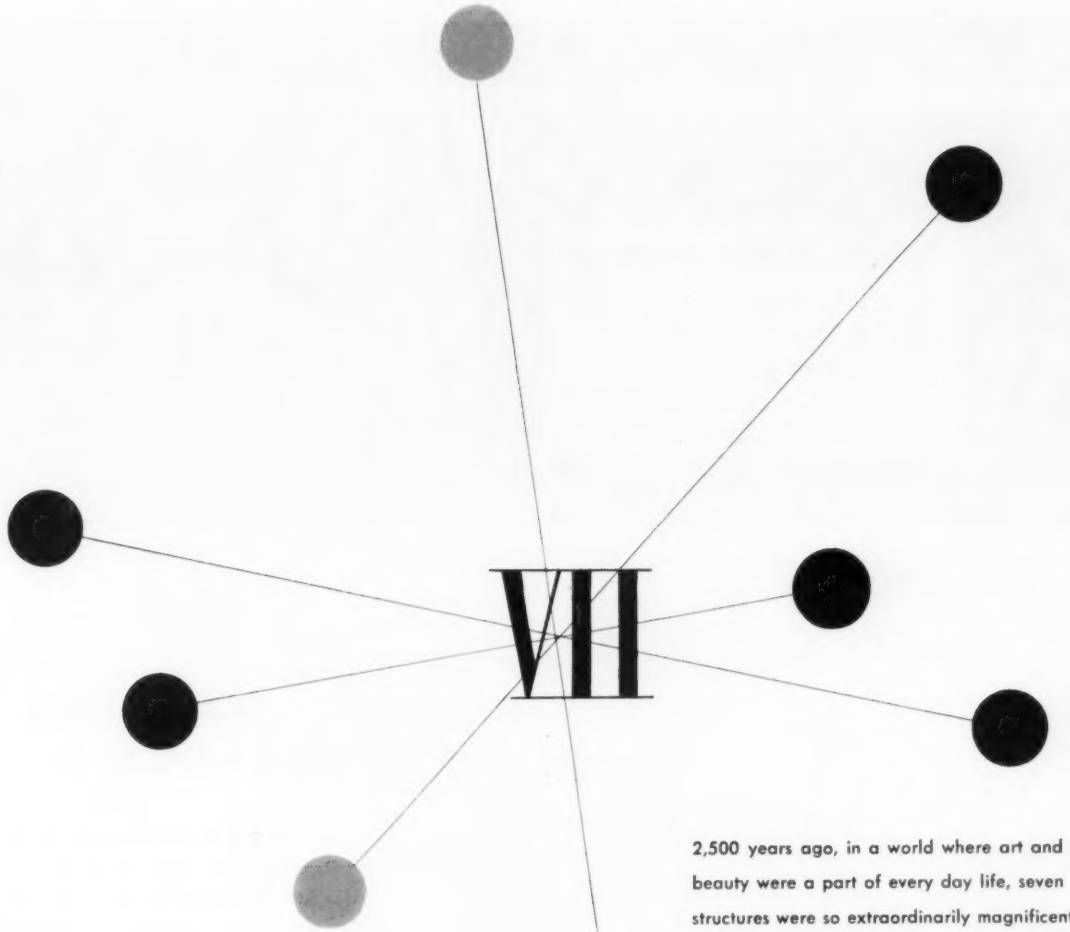

2,500 years ago, in a world where art and beauty were a part of every day life, seven structures were so extraordinarily magnificent that they attracted travelers by the thousands to see them. Even today with the wonders of plastics and nuclear science these same structures, though only one still exists, cause us to consider and wonder. In the following months we will present each of these "Seven Wonders" of the ancient world.

May we also present Plenco's quality controlled phenolics as a modern "wonder" of creative research and show you what it can mean to your business?

PLASTICS ENGINEERING COMPANY
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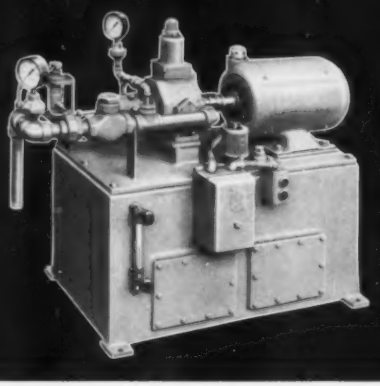
FOR BETTER PLASTIC PRODUCTS

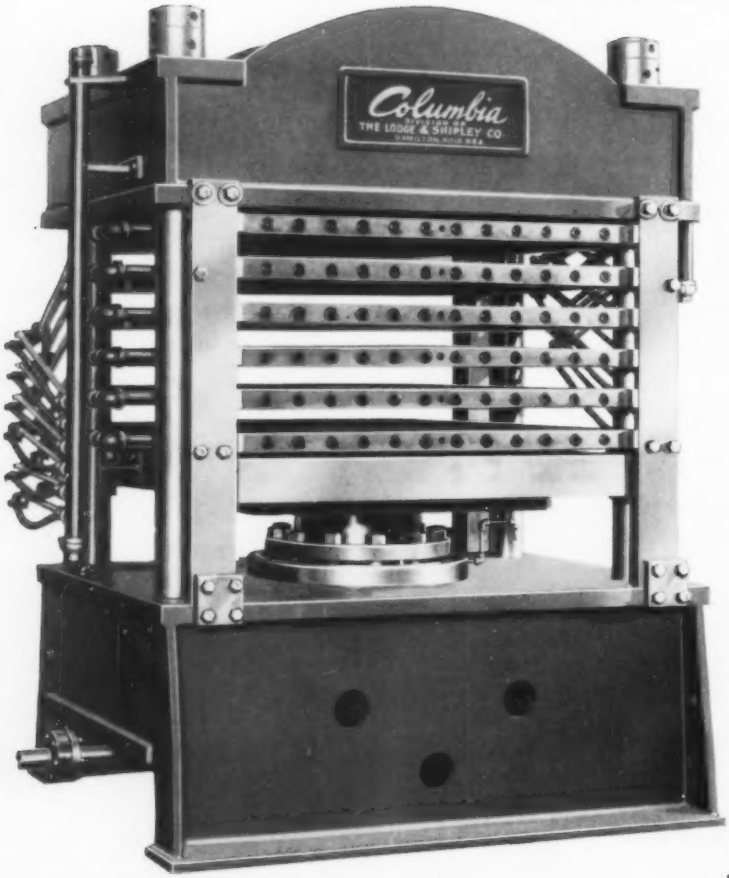
Columbia HYDRAULIC COMPRESSION MOLDING PRESS FEATURES

UNITIZED PUMP

A typical pumping unit combines pumping equipment, hydraulic reservoirs, gauges, valves, air filter and automatic vent in one trouble-free assembly.



Columbia design simplifies compression molding of plastics



Hydraulic Compression Molding Press — 300 T capacity, 36" x 36" platen

Each Columbia Hydraulic Compression Molding Press is engineered for its particular job, then built of standard units to provide a "custom" press at lowest price.

For example, the typical hydraulic pumping unit featured here centralizes all the equipment . . . pumps, reservoir, valves, filter, vent . . . minimizing piping, original and maintenance costs. Pumping equipment varies with individual requirements, providing operational characteristics as needed.

Special features and optional equipment can be provided with any Columbia Hydraulic Compression Molding Press to present a money-saving solution of your molding problem.

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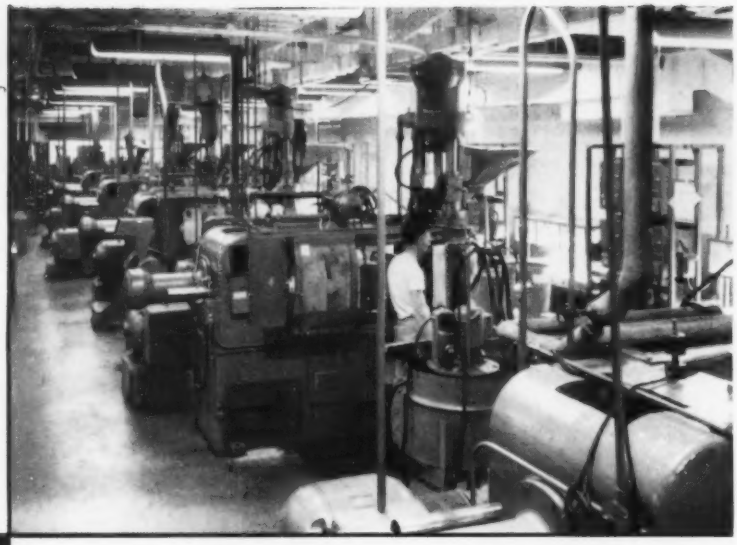
W. A. Sheaffer Pen Co.



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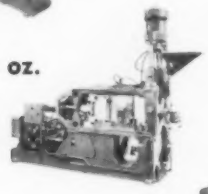
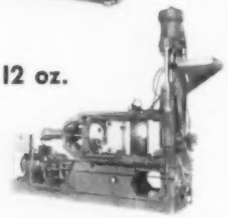
8 oz.



12 oz.



The modern fountain pen is a surprisingly precise and carefully assembled instrument. The mass-produced components must conform to rigid tolerances. This applies equally to the plastic parts, which must *also* undergo rigorous inspection for quality of finish.

In the modern, well-lighted, humidity-controlled, air-conditioned molding department of the Sheaffer Pen Company's new $3,500,000 plant at Ft. Madison, Iowa, plastic parts for Sheaffer pens and pencils are molded on the Lester 8 oz. Injection Molding Machines shown in the photograph above. The company also has 12 oz. and 4 oz. Lester Machines not shown in this photo. Sheaffer depends entirely on the Lesters for quality molding of the hundreds of thousands of plastic parts they produce yearly.

If you are interested in complete specifications on Lester Injection Molding Machines, we will be happy to send them to you. While you are at it, ask to be placed on the mailing list for the Lester-Phoenix house organ the Lester Press.

LESTER INJECTION MOLDING MACHINES

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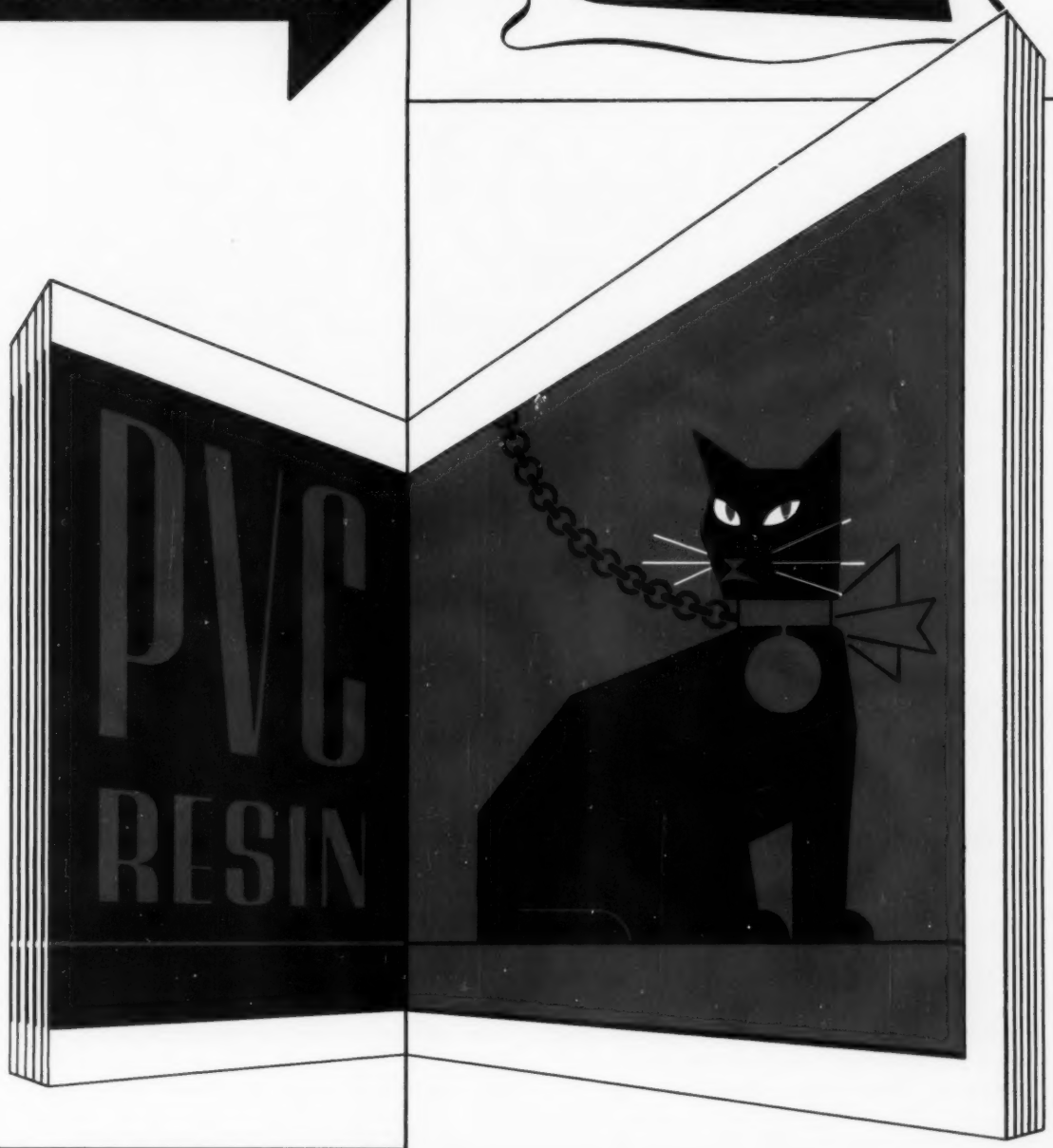


A. Torricelli

A MONTECATINI PRODUCT . . . . . AVAILABLE IN VARIOUS GRADES FOR ALL APPLICATIONS . . . . . PROMPT DELIVERY FROM STOCK IN U.S.A. & CANADA

CHEMORE CORPORATION

21 WEST STREET, NEW YORK 6, N. Y. TEL.: HA. 2-5275

for **TOUGH** molding jobs...

METASAP® STEARATES

deliver easier mold release

HAVE you tried Metasap Zinc or Calcium Stearates for easy ejection from the mold of intricate shapes, for deep drawing, or for larger-than-average pieces? You'll find they give just the results you want.

Blend these fine stearates into the molding compound—or sprinkle them on the molding surface. Either way, you'll find you need lower ejection pressures, get higher output, fewer rejects, better finished products. Molds last longer too.

So specify compounds containing Metasap Stearates or incorporate them into your own molding compound. Metasap Technical Service will gladly help you find the materials and mixing procedures best fitted to your production methods.

And to produce economical plastigels . . . Metasap offers a complete line of quality stearates, effective as thickening agents. Free testing samples of Magnesium, Barium, Calcium, or Aluminum Stearates are yours on request.

Reg. U. S. Pat. Off.

METASAP CHEMICAL COMPANY

METASAP CHEMICAL COMPANY, Harrison, N. J.

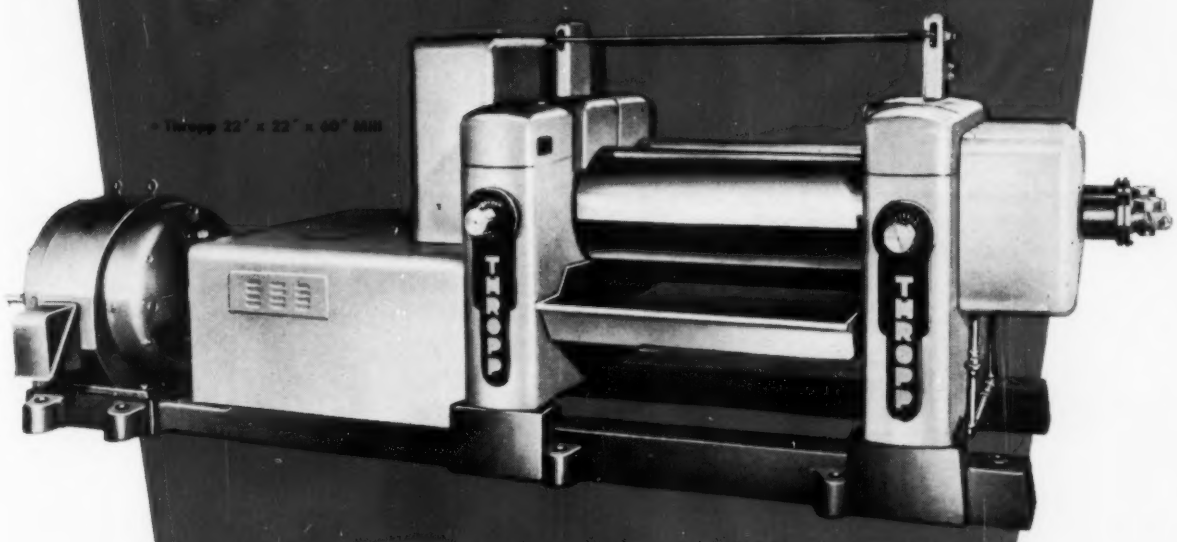
Chicago • Boston • Cedartown, Ga. • Richmond, Calif.

Stearates

of Calcium • Aluminum • Lead • Magnesium • Zinc

Here it is--

the mill YOU designed!



Built to stand continuous hard service in the Rubber and Plastics Industries

It was *your* experience, and that of many other rubber and plastics manufacturers that prescribed the specifications for this—our latest 60″ mill:

The clean, streamlined design affords a new concept in milling—combining minimum maintenance and maximum efficiency with superior performance.

Send for further information.

Wm. R. THROPP & Sons
Division of
J. M. Lehmann Company, Inc.
Lyndhurst, N. J.

Another new development using

B. F. Goodrich Chemical *raw materials*

The pump rod cups are made by The Dragon Manufacturing Company, Marietta, Ohio. B. F. Goodrich Chemical Company supplies only the Hycar rubber.

IT'S HYCAR-PHENOLICS FOR TOUGHER, LONGER LASTING PARTS

HERE'S a combination that can handle the *really tough* jobs—Hycar American rubber and phenolic resins. The oil well pump rod cups pictured above are molded from a Hycar-phenolic blend. They maintain high pump efficiency long after other cups would fail—extend the continuous operation of the pumps by as much as three months. Result—users gain higher well production and lower labor costs.

This outstanding performance is made possible by combining Hycar with a phenolic resin. The result is a compound with better shock, abrasion and fatigue resistance than ordinary rigid materials. Furthermore, Hycar-phenolics resist the deteriorating effects of oil and many chemicals and, because of their excellent processing characteristics, frequently solve the problem of molding intricate parts.

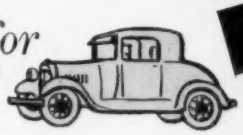
Hycar, either alone or in combination with other materials, may help you develop products that will stand up under severe conditions. For technical information, please write Dept. CF-1, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
A Division of The B. F. Goodrich Company

Hycar
American Rubber

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

1955 Cadillac for your '29 Ford?



21" picture screen for your old 12"?

Automatic Bendix for your old washboard?

no...

It's a new and completely different kind of offer!

Thermatron

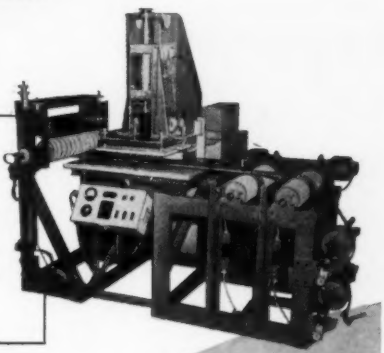
will give a

LIBERAL TRADE-IN ALLOWANCE on your present high frequency generators and presses!

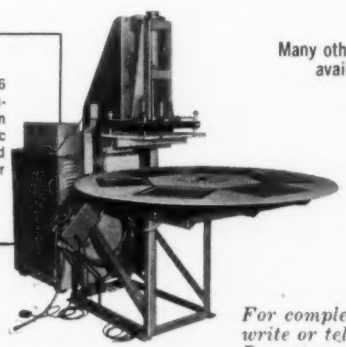
You've wanted *newer* or *larger* generators and presses, *more automatic* equipment for welding of plastic . . . But your present investment and the additional cash outlay needed was too big for your budget.

NOW, Thermatron offers a plan whereby you can turn in your present high frequency sealing and heating equipment for a liberal allowance toward newer, larger units that increase production and cut costs!

Thermatron Automatic Indexer used in conjunction with Thermatron electronic generator, feeds, indexes and rewinds complete rolls of vinyl in one automatic operation.



Large Thermatron P16 Press and automatic turntable used in conjunction with Thermatron electronic generator can be adjusted for up to 24 indexes per revolution.



Many other models available.

THERMATRON *for*

- **Plastic sealing**
- **Glue drying**
- **Reinforced fibre glass curing and asembly**
- **Plastisol curing**

...And many other applications

For complete information, write or telephone now to Department 92

Thermatron Division

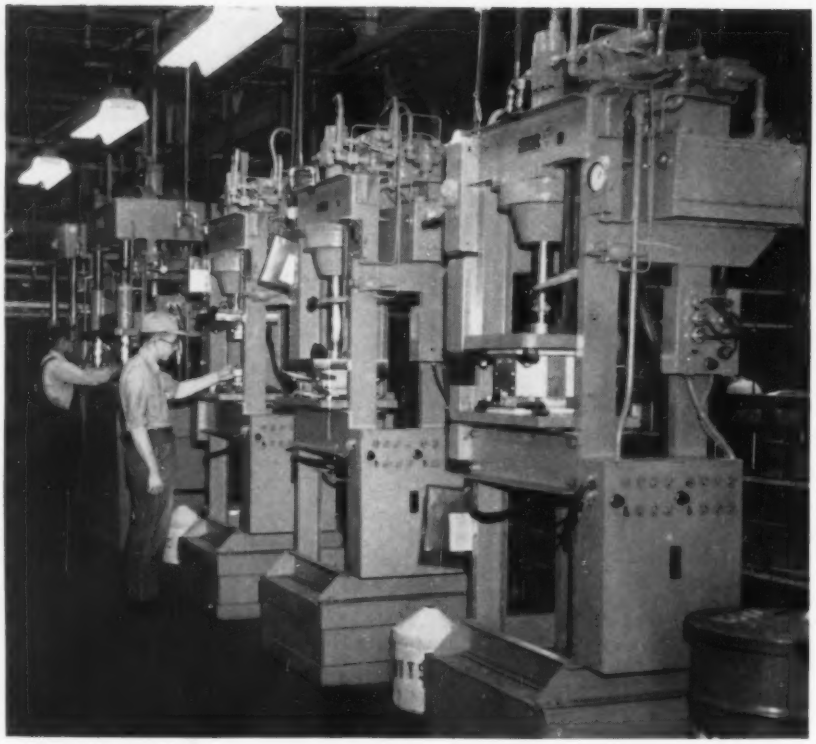
RADIO RECEPTOR COMPANY, INC.

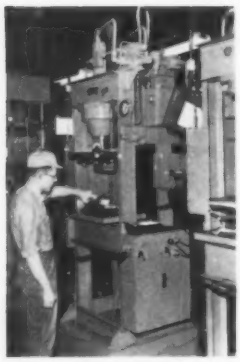
In Radio and Electronics Since 1922

SALES OFFICES: 251 West 19th St., New York 11, N. Y. WAtkins 4-8633
Chicago: 2753 West North Ave.
Los Angeles: Electroseal Plastics Co., 130 North Juanita Ave.
Factories in Brooklyn, N.Y.

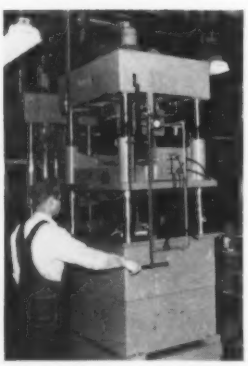
Thermatron

OVER 400 DIFFERENT AIRCRAFT PARTS *are molded on these Dake Plastics Presses*





Dake 25-ton H-frame Hydraulic Press, set to by-pass at 15 tons



Dake Hydraulic Guided Platen Press also has 25-ton capacity

Housings, junction boxes, map cases . . . these and hundreds of other aircraft parts are produced from Fiberglas laminate with this battery of Dake Plastics Molding Presses.

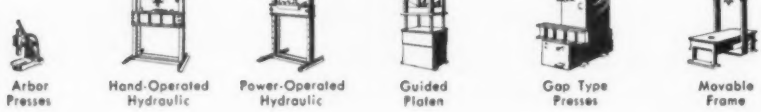
Starting with a few test parts, it quickly became apparent that these plastics had the strength, rigidity, and light weight required for aircraft use . . . and they could be produced at lower cost.

Maximum production savings came with the installation of the battery of five Dake Plastics Presses shown above. These presses are so accurate in their operation and so easy to control that quality improved steadily while production attained new high levels. As a result, plastics are now used for hundreds of additional parts.

Dake Plastics Presses are hydraulic, electrically operated, with dual palm control push buttons. They have adjustable pressure, electric timing, and automatic platen return, and many other features. Heated platens can be provided. For full information, write for Bulletin 273.

Dake Engine Company, 648 Seventh St., Grand Haven, Mich.

DAKE PRESSES



New Light* on an...

OLD PROBLEM!

*Resulting from study of different plant processes and their correlation with laboratory tests.

Troublesome "roll build-up" or "plateout" can be eliminated in most vinyl production. But just as this will-of-the-wisp phenomenon can be caused by many things, there are literally a host of remedies. The *trick* is to find the *right* one, or combination, to use in a specific situation.

Here at Ferro Chemical we've learned a lot about this problem and have been consistently successful in *keeping the pigments where they belong,* in the resin mass. In our work we have stabilized vinyls with many requirements—such as no sulphur staining, low toxicity, high heat and light stability —and where we haven't eliminated the condition entirely, we have substantially reduced it.

If you have such a problem and are losing film production due to calender roll build-up, we believe you'll be interested in a new booklet describing our experiences and practices. In it you'll find some helpful suggestions. The book costs you nothing. Why not write for it today?

FERRO CHEMICAL CORPORATION

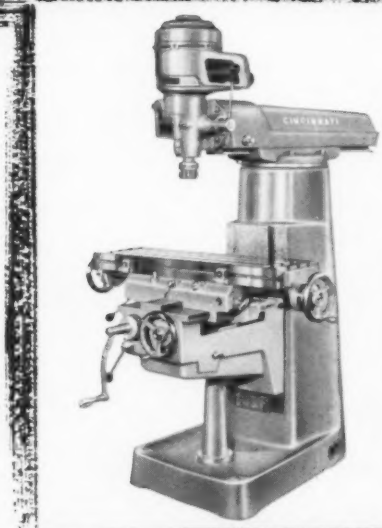
A Subsidiary of Ferro Corporation

450 KRICK ROAD • BEDFORD, OHIO

Everyone is talking about the NEW CINCINNATI TOOLMASTER MILLING MACHINE

Style 1B Toolmaster Milling Machine. Equipped with 1 hp spindle head; collet chuck type spindle nose, capacity ⅛" to 1" shank cutters; power feed to quill; worm positioning of swivel head.

Style 1B Toolmaster Milling Machine. Cincinnati rectangular overarm, square gibbed saddle-knee bearing, extra wide knee bearing on column face . . . these and other features constitute exceptionally sturdy construction for maximum hp cuts.



Meet the newest member of Cincinnati Milling's extensive line of machine tools . . . the Toolmaster. There are three styles of these sturdy toolroom milling machines:

1A—Manual feed to quill
1B—Power feed to quill
1C—Heavy duty spindle head

Toolmaster Milling Machines constitute a new opportunity to reduce costs in shops of all sizes; in toolrooms, metal pattern shops, contract machine shops, tool and die shops. You can depend upon any machine tool bearing the name plate of The Cincinnati Milling Machine Co. Would you like to know more about this new Toolmaster? Write for new four-color catalog, No. M-1870.

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

Style 1C Toolmaster Milling Machine. Equipped with 2 hp heavy duty spindle head; built-in motor; 8 spindle speeds; No. 40 standard spindle nose.

CINCINNATI

MILLING MACHINES • CUTTER SHARPENING MACHINES • BROACHING MACHINES • METAL FORMING MACHINES • FLAME HARDENING MACHINES OPTICAL PROJECTION PROFILE GRINDERS • CUTTING FLUID

Now Puerto Rico Offers 100% Tax Exemption to New Industry

by BEARDSLEY RUML

"We don't want runaway industry" says Governor Muñoz. "But we do want new and expanding industries. To get them, we promise freedom from all taxes—local and Federal." That's one reason why hundreds of U. S. manufacturers are locating new plants in Puerto Rico, where they are protected by all the guarantees of the U. S. Constitution.

Beardsley Ruml

IN A dramatic bid to raise the standard of living in Puerto Rico, the Commonwealth Government is now offering U. S. manufacturers such overwhelming incentives that more than three hundred new factories have already been established in this sun-drenched island 961 miles off the Florida coast.

First and most compelling incentive is a completely tax-free period of ten years for most manufacturers who set up new plants in Puerto Rico.

For example, if your company is now making a net profit after taxes of $53,500, your net profit in Puerto Rico would be $100,000—a gain of 87 per cent as a result of non-applicability of U. S. Corporate Income Tax in Puerto Rico.

Your dividends in Puerto Rico from a corporation there could be $50,000 against $25,000 net in the U. S.—thanks to the non-applicability of the U. S. Income Tax.

What About Labor?

Puerto Rico's labor reservoir of 650,000 men and women has developed remarkable levels of productivity and efficiency—thanks, in part, to the Commonwealth's vocational training schools. These schools also offer special courses for managers and supervisors.

The progress made in technical skills may be gauged from the fact that there are now twenty-eight factories producing delicate electronic equipment.

Among the U. S. companies that have already set up manufacturing operations in Puerto Rico are Sylvania Electric, Carborundum Company, St. Regis Paper, Remington Rand, Univis Lens, Shoe Corporation of America, and Weston Electric.

CORPORATE TAX EXEMPTION

If your net profit after U. S. Corporate Income Tax is:	Your net profit in Puerto Rico would be:
$ 17,500	$ 25,000
29,500	50,000
53,500	100,000
245,500	500,000
485,500	1,000,000

DIVIDEND TAX EXEMPTION

If your income* after U. S. Individual Income Tax is:	Your net income in Puerto Rico would be:
$ 3,900	$ 5,000
7,360	10,000
10,270	15,000
14,850	25,000
23,180	50,000
32,680	100,000
43,180	200,000
70,180	500,000

*These examples are figured for dividends paid in Puerto Rico to a single resident. Based on Federal rates effective Jan. 1, 1954.

"Close to Paradise"

Listen to what L. H. Christensen, Vice President of St. Regis Paper, says:

"The climate is probably as close to paradise as man will ever see. I find Puerto Ricans in general extremely friendly, courteous and cooperative.

"This plant in Puerto Rico is one of our most efficient operations, in both quality and output. Our labor has responded well to all situations."

Mr. Christensen might have added that the climate is magnificent, with temperatures in the 70's twelve months a year.

The swimming, sailing and fishing are out of this world. Your wife will rejoice to hear that domestic help is abundant.

The Commonwealth will leave no stone unturned to help you get started. It will build a factory for you. It will help you secure long-term finance. It will even screen job applicants for you—and then train them to operate your machines.

Transportation

Six steamship companies and four airlines operate regular services between Puerto Rico and the mainland. San Juan is just 5½ hours by air from New York.

Light-weight articles such as radar components come off the line in Puerto Rico one day and are delivered by air freight next day in California, Chicago and other mainland cities. And, of course, there is no duty of any kind on trade with the mainland.

Are You Eligible?

Says Governor Muñoz: *Our drive is for new capital. Our slogan is not "more something old to Puerto Rico," but "start something new in Puerto Rico" or "expand in Puerto Rico."*

The Commonwealth is interested in attracting all suitable industries, and especially electronics, men's and women's apparel, knitwear, shoes and leather, plastics, optical products, costume jewelry, small electrical appliances, hard candy and pharmaceuticals.

To get all the facts, and to find out whether you and your company would be eligible for complete tax exemption, mail the coupon below.

MAIL THIS COUPON

Economic Development Administration
Commonwealth of Puerto Rico, Dept. P-1
579 Fifth Avenue, New York 17, N. Y.

Mail me "Facts for Businessmen," your report of the advantages of Puerto Rico for plant location.

Name_____

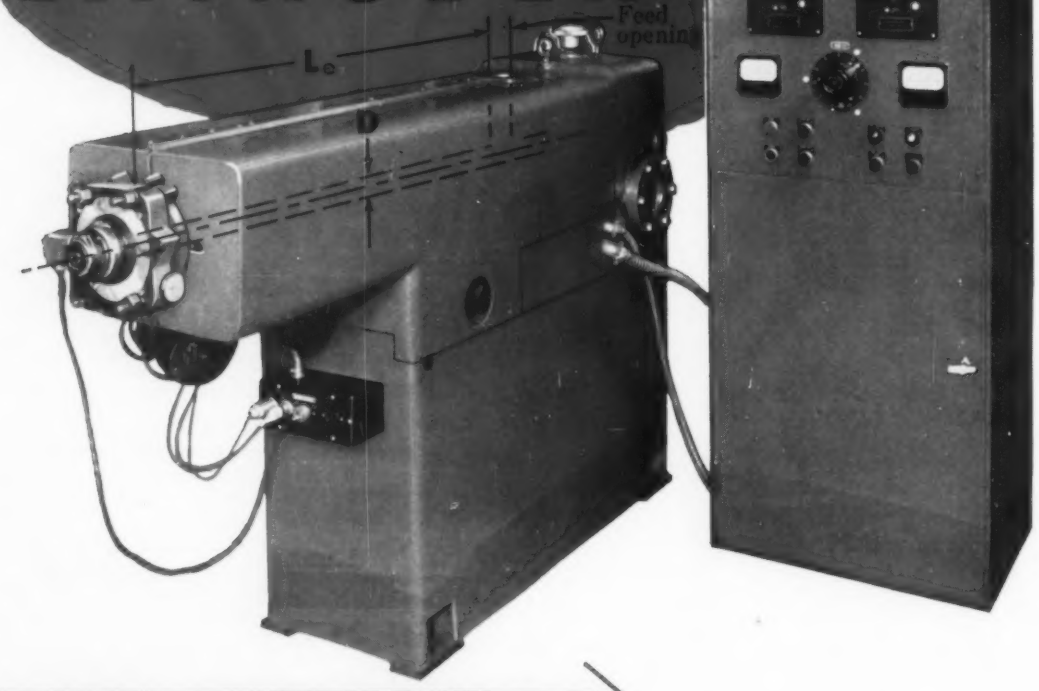
Title_____

Company_____

Address_____

NRM

NEW 2½ INCH 20:1 L_e/D Ratio THERMOPLASTIC EXTRUDER



OFFERS THE PLASTIC INDUSTRY

- **HIGHER PRODUCTION of**
- **FINER QUALITY EXTRUSIONS**
- **FROM THERMOPLASTICS**

Whatever your requirements . . . for pipe, sheet, film or custom extrusions, the new NRM 2½" 20:1 ratio Model 55 Extruder offers you *more* high quality pounds per hour production than any other extruder of comparable size. Here's why . . .

2358

GREATER EFFECTIVE LENGTH OF CYLINDER AND SCREW IMPROVES PLASTIC *HEATING* AND *WORKING* CHARACTERISTICS

INCREASES PRODUCTION UP TO 50%

Always recognizing the importance of extruder Le/D ratio (length of cylinder to its diameter) in relation to the quality — and quantity — of extrusions production, NRM has never relaxed its researches to find a more efficient ratio for extruders of given size. When these researches indicated that our already high-performing 16:1 2½" Extruder might do even better in a higher Le/D ratio, we lost no time in building experimental machines and making tests, as necessary, to prove our theories. That was many machines and many tests ago.

Today, the fruit of this work is the new 2½" 20:1 ratio Extruder, *another* NRM "first," which we are now making available to the plastics industry. Until the introduction of this Extruder, our Model 50 2½" with 16:1 Le/D ratio was the champion producer in its class. For example, these Extruders in the field regularly produce high quality extrusions at 60 to 90 pounds per hour. The *new* 20:1 has surpassed even this performance with 120 to 125 pounds per hour — and the finish and shape-holding qualities of the extrusions are better still.

What makes it possible? In this small space we cannot *begin* to give the engineering details. While these results are certainly not all due to cylinder length, it is true that the *extra* exposure to heating, and the extra mechanical working picked up by the plastic on its *longer* path to the die, make a whale of a lot of improvement in both quality and quantity of the extrusion. Why 20:1 is the most effective ratio, and why this feature has not been incorporated into extruders before now, are details we can make clear to you readily enough in direct discussions, or better, at an actual demonstration which we will be happy to arrange.

More important to *you* are the *performance facts* of the NRM 2½" Model 55 20:1 ratio Extruder. The Geon rigid vinyl test runs shown here will help you appreciate these more fully. They are taken from among the *many* tests made in the development and perfection of the 20:1, and are typical of its production at varying rates of speed and horsepower. Tests using the rigid vinyls of other producers, and tests with various other plastic materials, show corresponding increases in both production rate and quality.

TEST RUN #471 12-15-54

MACHINE—2½" Electric-Heated Model 55 Plastics Extruder—20:1 Slenderness ratio
SCREW—Single Flighted into Short Torpedo—Compression ratio 3:1
DIE—¾" I P S Pipe Die—No Screens or Breaker Plate
MATERIAL—Rigid Vinyl—Geon—8700-A Gray (Goodrich)
FORM—Cubes

Run	Screw Temp	Feed Box Temp.	Hopper Cyl. Temp.	Mid-Cyl. Temp.	Head Cyl. Temp.	Gate Temp.	Die Body Temp.	Die Lip Temp.	Stock Temp.	R.P.M.	Horse-power	Lbs./Hr.	Quality
1	NEU*	NEU*	310	330	330	340	310	320	350	10	6.1	60	Good
2	NEU*	NEU*	300	300	300	330	320	320	350	15	6.5	75	Good
3	NEU*	NEU*	300	300	300	330	310	320	350	20	7.3	93¾	Good
4	NEU*	NEU*	300	300	300	330	315	315	350	22½	8.1	123¾	Good
5	NEU*	NEU*	320	315	315	330	320	325	350	22½	8.1	123¾	Good

*NEUTRAL—

IN "PACKAGED" INSTALLATIONS OR IN "BIG PLANT" OPERATIONS THE *NEW* NRM 2½" 20:1 EXTRUDER INCREASES PRODUCTION . . . PROFIT

Our 20:1 Le/D Extruder is just one more step taken in the NRM tradition of being *first* with "big things" for better plastic production. Undoubtedly there are other ways, too, in which plastics extruders can be improved, and eventually our *continuing* researches will find them. But *whatever* your work, we can say that the *new* Model 55 NRM 20:1 ratio Extruder will fit more compactly into your production system, and produce more top quality extrusion-pounds per hour than any other extruder of equal size without this feature. We invite you to contact us for complete details and a demonstration.

NRM

NATIONAL RUBBER MACHINERY CO.

General Offices and Engineering Laboratories, 47 West Exchange St., Akron 8, Ohio—Hemlock 4-3131
Eastern Plant: 284 Getty Ave., Clifton, N. J.—Passaic, N. J.—Prescott 7-7500
West: S. M. Kipp, Box 441, Pasadena 18, Calif.—Sycamore 4-2110
Export: Orbit Products Corporation, 460 Fourth Ave., New York, N. Y.—Lexington 2-1370

Get "20:1 Quality and Performance" with NRM 20:1 Le/D Extruders

New life *for famous old trademark . . .*

Authentic replica, in easy-to-build kit form, insures instant acceptance, wide audience

In an era of "hard sell" the use of premiums takes on added importance. But today there's a new approach to premium evaluation, design and construction. The "ideal" should contain all of these elements:

. . . be easily shown, "sold" and demonstrated;
. . . have broad, family-wide interest and appeal;
. . . be light weight, to insure minimum shipping expense and breakage;
. . . must build permanent good will for advertiser;
. . . have a long and active promotional life;
. . . be readily identified with the product;

This is an apt description of the Twenty-Mule Team replica designed and produced by Revell for Pacific Coast Borax Co. This realistic, authentic scale model . . . 42½ inches long when assembled . . . *brought to life* this famous century-old trademark. Dramatically detailed, this easy-to-assemble model kit is realistic down to the fine rivet heads and the wood-grained pattern on the wagon.

Here is a premium that wins friends (who pay for the privilege *of proudly displaying this trademark in their homes!) and is earning the enthusiastic support of dealers who are eager to utilize this traffic-stopping display!*

Do you want to add new life to your trade mark . . . new sales for your product? Then consider a Revell-inspired authentic scale replica, in easy do-it-yourself kit form . . . the newest, strongest factor in premium promotion. They're low in cost, yet have a high value to the consumer. They inspire publicity with their news worthiness. They insure repeat sales of your product because one completed model stimulates the desire to build another . . . and another. This makes "collectors" out of "casual" purchasers of your product.

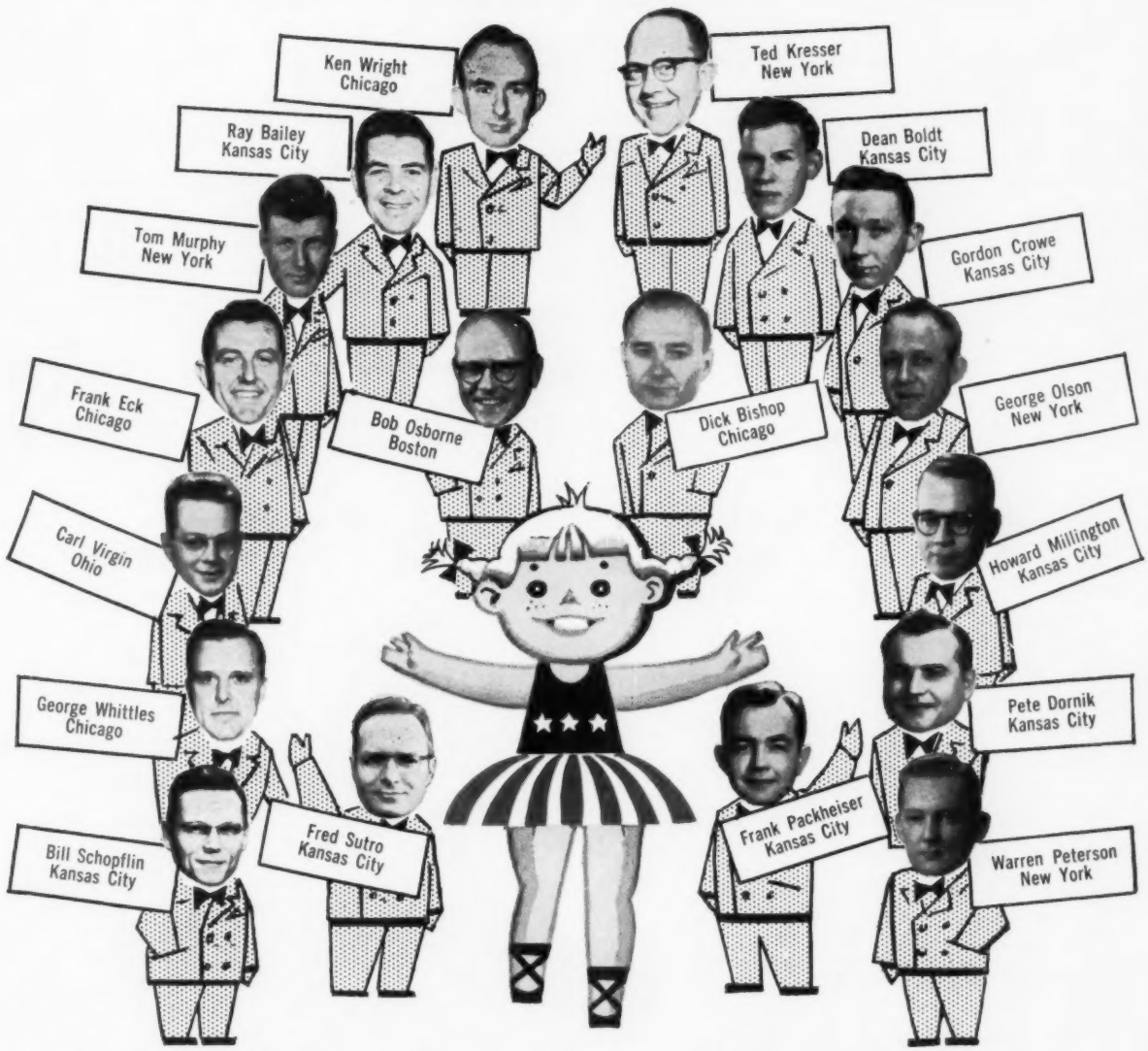
As the world's largest designers and producers of authentic plastic model kits, Revell's engineers welcome your challenge to create the *unusual* premium.

For authentic scale models, expertly reproduced with museum-like quality **rely on**

Revell
Authentic Kits

REVELL, INC. • 4223 OCEAN PARK AVENUE • VENICE, CALIFORNIA
NEW YORK OFFICE: ROOM 1260 • 200 FIFTH AVE. BLDG.

Introducing Poly-Eth and her pals...

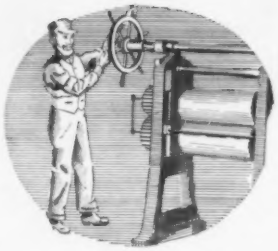


Pert little Miss Poly-Eth is Spencer's trademark for polyethylene. Her pals, the Spencer Sales and Technical Service team, are ready now with ideas that could help you engineer better products. Soon, Spencer's new multi-million-dollar polyethylene plant at Orange, Texas will be in production. Why not drop us a line?

Poly-Eth™ by **SPENCER**

SPENCER CHEMICAL COMPANY • 610 DWIGHT BLDG., KANSAS CITY, MISSOURI

In the good old days



WHEN GRANDPA RAN THE WASHING MILL

WHEN the boom gave a much needed new volume of business to the solid tire rubber shops . . . When we bought one of the first of those new-fangled contraptions, the , to make out our payroll checks . . . When said payroll check for our boss was . .

ERIE FOUNDRY WAS A GREAT NAME IN COMPRESSION PRESSES

in today's plastic shop

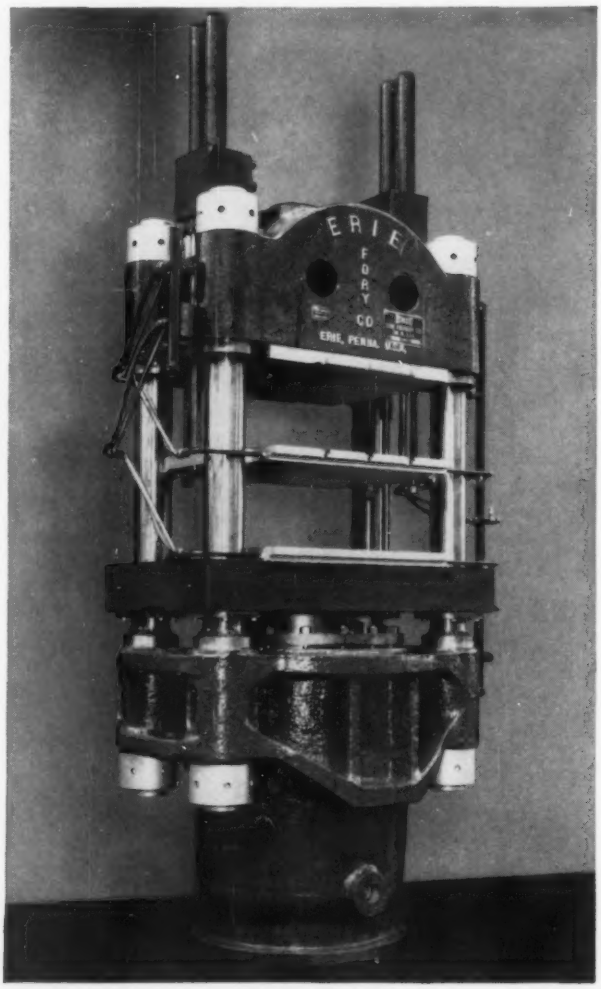
...When high pressures evenly applied to parallel platens guarantee precision molding with thin flash lines

...When product perfection means money saved and money earned

...When competitive bidding demands maximum service for minimum cost

ERIE
SIXTIETH YEAR

is by far the greatest name in special precision compression presses



ERIE FOUNDRY CO. ERIE, PA.

THE PLANT BEHIND THE PRODUCT

SERVING the ENTIRE PLASTICS INDUSTRY

Gering

CUSTOM COMPOUNDING
complete equipment to produce large quantities of molding and extrusion compounds

DRYCOL
perfected medium for easy-on-the-spot dry coloring—standard and special effects

S-T-R-E-T-C-H
polyethylene colorant — saves up to 15c per product lb.—easy, clean, safe, dustless

STYROMIX
blended ready-mixed styrene in required color — money-saver — production-speeder

PURGING COMPOUND
specially formulated rapid releasing agent for injection molding machine cylinders.

RE-PROCESSING
of plastic scrap and obsolete molding powders—we buy and sell

POLYETHYLENE
POLYSTYRENE
VINYLS
ETHYL CELLULOSE
BUTYRATE (Tenite II)
ACETATE
ACRYLICS
NYLON

GERING PRODUCTS INC., KENILWORTH, N. J.

"PIONEERS IN MODERN PLASTICS FOR OVER 30 YEARS"

Here's Marvibond*

a new vinyl-to-metal laminating process that gives sheet metal products all these advantages...

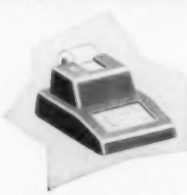
- lasting protection against rust and corrosion
- practically any surface effect desired
- superior abrasion resistance
- outstanding resistance to perspiration and most chemicals
- uniform coverage of almost any thickness
- good sound-deadening properties
- less costly fabrication

WHY NOT Marvibonded...?

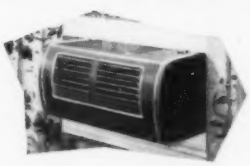
..auto instrument panels and interior trim

vending machine housings

waste baskets



business machine housings



air conditioner cabinets

Window moldings and dashboards of Marvibonded laminates could be permanently clad with vinyl material to match door upholstery and seat trim. And practically any choice of texture is possible–from glare-free matte finishes to rich leather-like grains.

There'd be no checking or flaking, no worries about scratched paint—no need for waxing or other care. The tough, chemical-resistant vinyl cleans with a wipe.

What's more, the vinyl surface would always be warm and pleasant to the touch. Marvibonding ends problems of rust from moisture condensation. And it helps to deaden sound, as well as insulate against squeaks from metal to metal contact.

Why not Marvibonded panels and trim! Plenty of excellent reasons *why*. Excellent reasons why for hundreds of similar applications—like radio and television housings, business machine covers, vending machines, air conditioners, waste baskets, and many many more.

Better see what Marvibond can mean to your product! Write the address below today.

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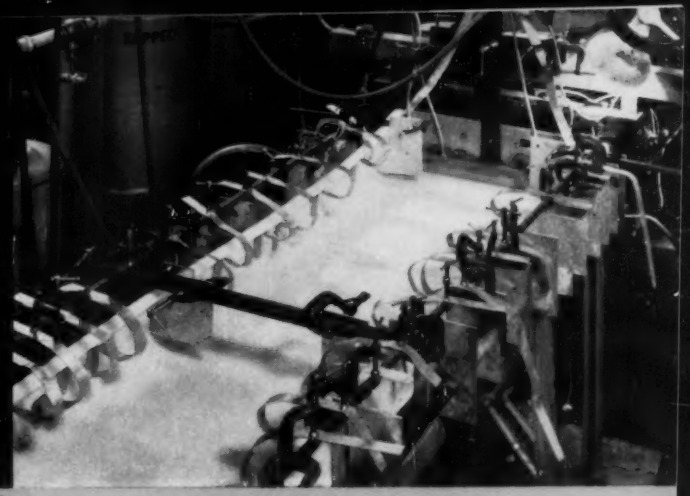

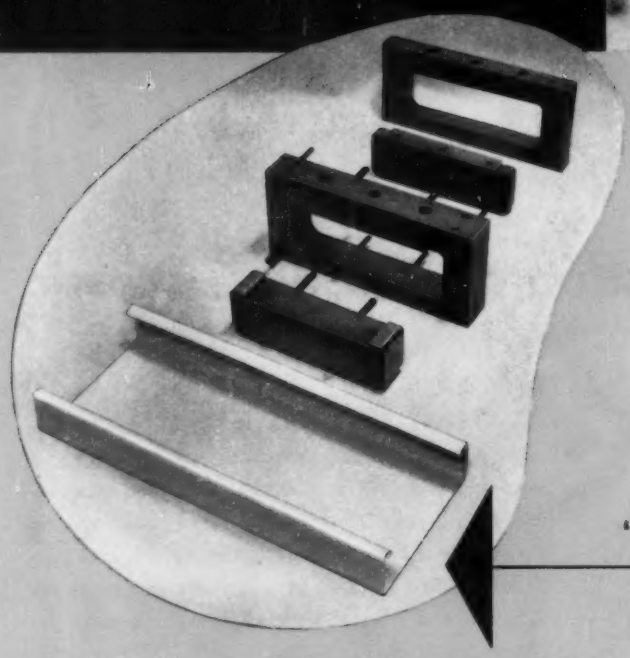

Cascade
pre-hardened DIE STEEL at ROCKWELL C 35

"... filled our extrusion die needs perfectly"

Latrobe's Cascade precipitation hardened die steel was used for the large extrusion dies (shown above) by Plaskolite, Inc., Columbus, Ohio. These dies are used to extrude plastic diffusion plates for overhead lighting fixtures.

Plaskolite, Inc., found these three distinct advantages when using Latrobe's Cascade...

1. No heat treating required after finishing—an advantage since close tolerances were required on these large extrusion dies.
2. Cascade's hardness (Rockwell C 35) is high enough to protect dies from damage during die changes.
3. Cascade's superior finish produces plastic extrusions with extremely high finish.

The outstanding characteristics of pre-hardened Cascade have been noted by plastic mold makers everywhere . . . clean cut machined surfaces, free from tears, save costly bench cleanup time . . . uniform hardness even in large sizes—the result of Cascade's precipitation hardening property . . . plus outstanding polishing qualities. Call your Latrobe representative today.

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TOO ROUGH

Get the Certain Protection of KEL-F® Plastic

KEL-F Plastic can supply many of the answers to plant equipment corrosion problems. This fluorocarbon plastic is inert to virtually all chemical attack—including mineral acids, oxidizing agents as well as strong caustics.

HIGH COMPRESSIVE STRENGTH

KEL-F Plastic is outstanding for its resiliency and resistance to cold flow. Ring seals and gaskets molded of KEL-F Plastic exhibit a low percentage of deformation under load—retaining seals longer and more effectively.

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KEL-F Plastic has unusually high resistance to temperature extremes—exhibits satisfactory properties over a temperature range of approximately 710° F. (—320° F. to 390° F.)

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The non-adhesive properties of KEL-F Plastic are particularly advantageous in the handling of viscous fluids, and in maintaining clean, unclogged lines and equipment.

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KEL-F Plastic is readily molded—by injection compression or extrusion. Its dimensional stability and low mold shrinkage make it ideally suited to molding with metal. The techniques of molding this fluorocarbon have been fully developed, and perfected. Today, KEL-F Plastic parts and products are produced in volume by molders throughout the country.

Modern processing methods demand plant equipment with greater resistance to corrosion, temperature extremes and higher pressures. The weak links in such equipment are the valves, gaskets and seals. KEL-F Plastic is providing the solution to many of these problems, and producing demonstrable results in reduced downtime and lowered maintenance costs. It is available as a molding compound, or it can be obtained in rods, tubing, sheets and film from a number of suppliers. It is also available in dispersions, suitable for bake-coating on metals and certain non-metals. The full story of KEL-F Polymer should be in your active file. Write us.

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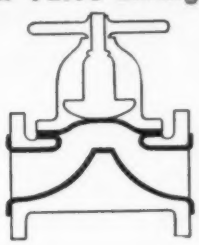

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* *" . . . As grain gives wood its character, so glass fibers give character to the appropriate resin."*

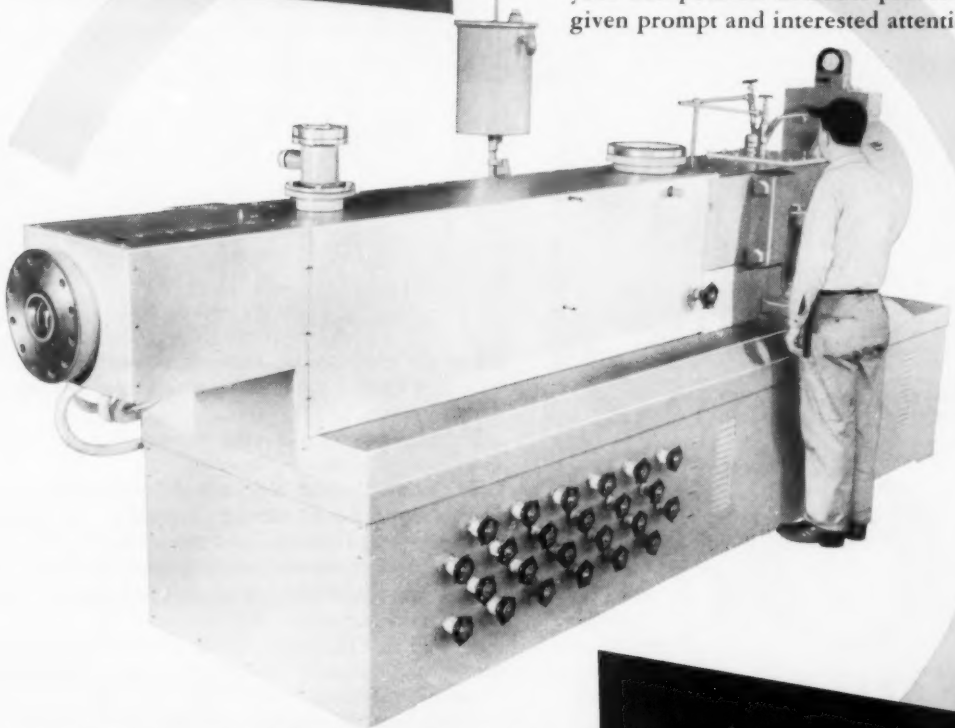
NOW AVAILABLE—

EXTRA POWER

INCREASED POWER CAPACITY, 50% above previous designs, is now available in most sizes of W. E. I. machines. This permits the application of the W. E. I. dual worm Compounder Extruder to a wider range of difficult processing problems.

The reputation of the W. E. I. Compounder Extruder grows in direct proportion to its dual worm efficiency, with its ability to take on new and bigger processing assignments. The record is for all to read: the popularity of the W. E. I. dual worm Compounder Extruder has grown from year to year since its introduction in 1944 with more and more machines functioning on a busy production, sound profit schedule. It is interesting to note that many of these Compounder Extruders are working on new and different processing assignments in 1955. They needed very little, if any, mechanical change other than dual worms with different flight characteristics when required.

Our Research, Engineering, and Sales Departments work hand in hand for better service to both customer and prospect. Your inquiries and your Compounder Extruder problems are always given prompt and interested attention.



The extra power and the almost limitless combinations of W. E. I. Dual Worms keep our equipment at work year after year in perfect step with plastics processing progress —a record like this protects your profits and your management reputation.

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PITTSBURGH 508 PREFORM ROVING

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PPG #508 Preform Roving is definitely superior because it has been treated by a special sizing process to insure better chemical and mechanical bond between glass fibers and molding resin. Results: consistently high quality moldings, lower scrap rate, faster preforming.

Check out PPG's new 508 Preform Roving on your own molding jobs and see the difference. You can get complete information on standard packages and available sizes by simply contacting our executive offices or our district sales offices in Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis or Los Angeles. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

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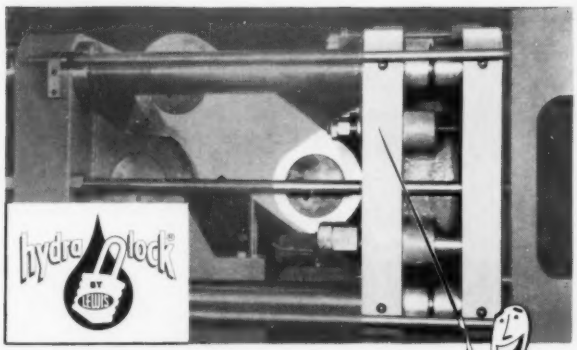
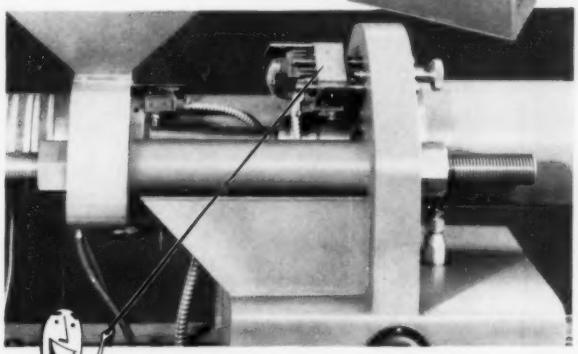
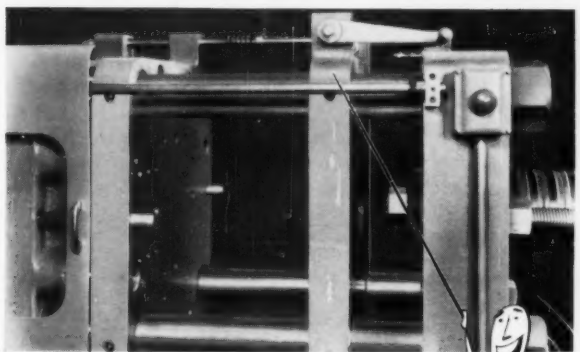
HERE'S WHY PRODUCTION MOLDERS SPECIFY THE LEWIS "6"



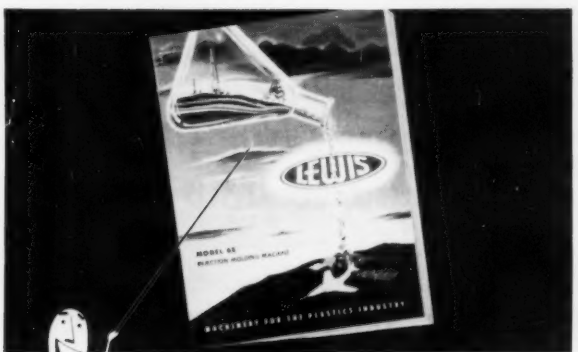
HYDRA-LOCK® . . . the exclusive fast-operating 200-ton clamp that permits Model "6" to do the work of much larger machines.



COMPENSATING FEED MECHANISM . . . that provides continuous compensation between feed and injection while machine is operating.



SPECIAL DIE-LOCK DEVICE . . . another LEWIS exclusive, permits release of dies and clearing of jammed nozzle in 20 seconds.



FOR THE COMPLETE STORY . . . including other outstanding LEWIS "6" features and specifications . . . write today for BULLETIN 102.

The LEWIS "6" injection molding machine is designed to mold large projected area parts formerly requiring larger, more expensive machines . . . to do the job faster, better and at lower cost. This versatile new machine is creating excellent case histories for volume production with minimum scrap. Intricate polystyrene parts weighing more than 7 ounces have been molded at rate of 2-1/2 shots per minute.

Continual improvement . . . based on precision, safety and cost-conscious engineering . . . has made Model "6" one of the safest, most efficient molding machines available today. Its automatic cycle, powerful new clamping mechanism, high injection pressures, low cost operation and foolproof safety features are proving that the LEWIS "6" is the new champion among top-quality molding machines.

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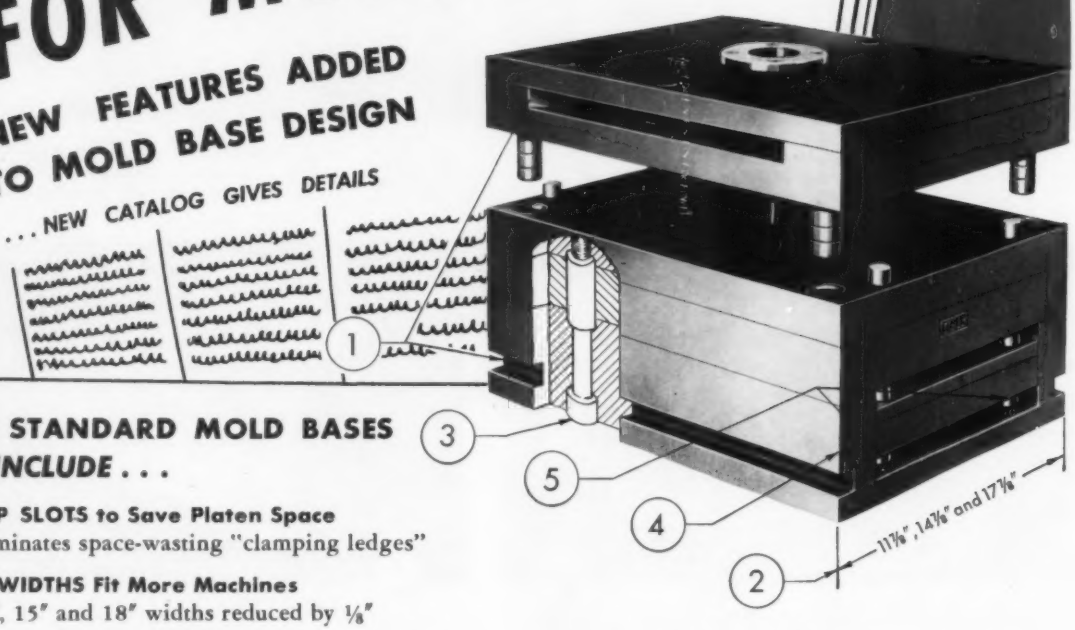
DME News

HERE'S BIG NEWS FOR MOLDMAKERS

NEW FEATURES ADDED TO MOLD BASE DESIGN

. . . NEW CATALOG GIVES DETAILS



D-M-E STANDARD MOLD BASES *NOW INCLUDE . . .*

1. **CLAMP SLOTS to Save Platen Space**
   Eliminates space-wasting "clamping ledges"
2. **NEW WIDTHS Fit More Machines**
   12", 15" and 18" widths reduced by ⅛"
3. **MORE ROOM for Waterlines**
   Tubular Dowels eliminate obstruction
4. **RIGID CONSTRUCTION with Less Parts**
   One piece Ejector Housing gives added strength
5. **STOP PINS WELDED to Ejector Bar**
   Prevents loosening and ejection interference

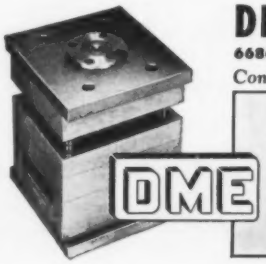
New 182-Page CATALOG Gives Complete Specifications and Prices . . .

The revolutionary features pictured here are now STANDARD on all D-M-E Mold Bases (except the 9" wide series). They represent the ultimate in Standard Mold Base development and are designed to give you the finest in mold base construction.

These added features make D-M-E Standards even more useful in saving you valuable time and money on all your moldmaking jobs!

If you have not already received D-M-E's Completely New CATALOG, contact your nearest D-M-E Branch TODAY! It contains complete mold base specifications as well as helpful design data and tables.

. . . it's the HANDBOOK of the Plastic Industry!



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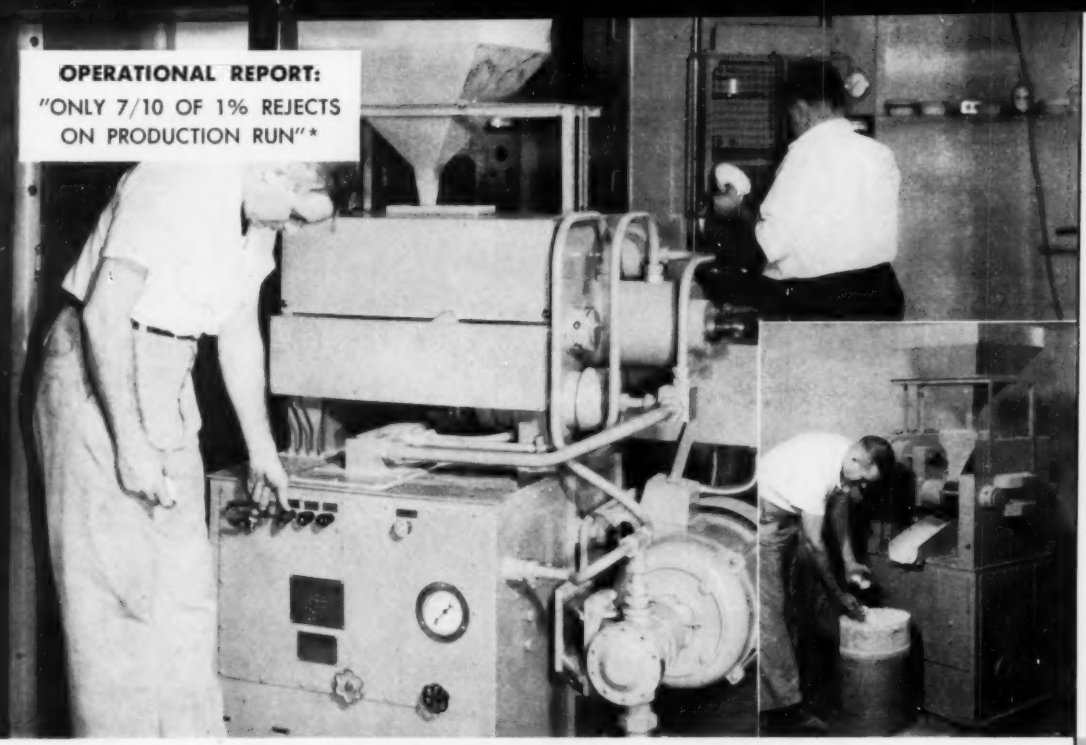

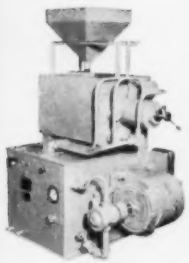

Remarkable uniformity of preform density, weight and pre-heating with

BIPEL Hydraulic Pelleters

* Unsolicited reports like this . . . coming from field installations of internationally-famous BIPEL Horizontal Hydraulic Pelleters prove that these precision-built units are *unmatched in performance and economy* . . . anywhere! Just since their first public showing last June, installations are producing in key areas in 10 states! If you're investing in preformers, don't overlook the built-in features of the BIPEL, the service behind it, and the experience and integrity of the manufacturer. *Write for illustrated booklet and prices.*

Features: **Uniform Density** . . . die rides free during compression, allowing equivalent pressure on *both* punches. This, plus accurate hydraulic loading, insures constant uniform density. **Preforms Most Powders** . . main ram compresses powder only, with *steady squeeze*, not mechanical blow. Complete control for amount of "dwell" or pressure desired. Double pressing arrangement available to allow for escape of air in preforming difficult powders. **Damage-proof Operation** . . . no moving parts come between punches. **Clean, Quiet** . . . fills from *within* hopper for dust-free, quiet operation; can be cleaned in minutes between runs. **Labor Saving** . . . finished preforms are so strongly made that they may be discharged into tote boxes or drums unattended. One operator can easily supervise several units. **No Powder Loss** . . . all powder is pelleted; no spillage. **Higher Production Rate** . . . from multiple punch sets; punches for special shapes available. **Controls** of all operating variables located conveniently for instant settings. **Service** . . . all normal replacement parts in stock in U.S.A. for immediate shipment if needed. Electricals to suit.

maximum pressure	12 tons	35 tons	70 tons
maximum strokes per hour	2600	1500	850
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*based on average powder density of .35 ozs. per cubic inch

"BIPEL" is a Registered Trade Mark

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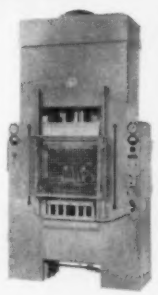

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Perfect companion to the Bipel Pelleter . . . the semi-automatic BIPEL "Auto-Control" Compression/Transfer Presses can reproduce any conceivable molding cycle at the touch of a button! Adds several extra cycles per hour. Variable range of pressures: 20 to 340 tons. *Write for complete details.*

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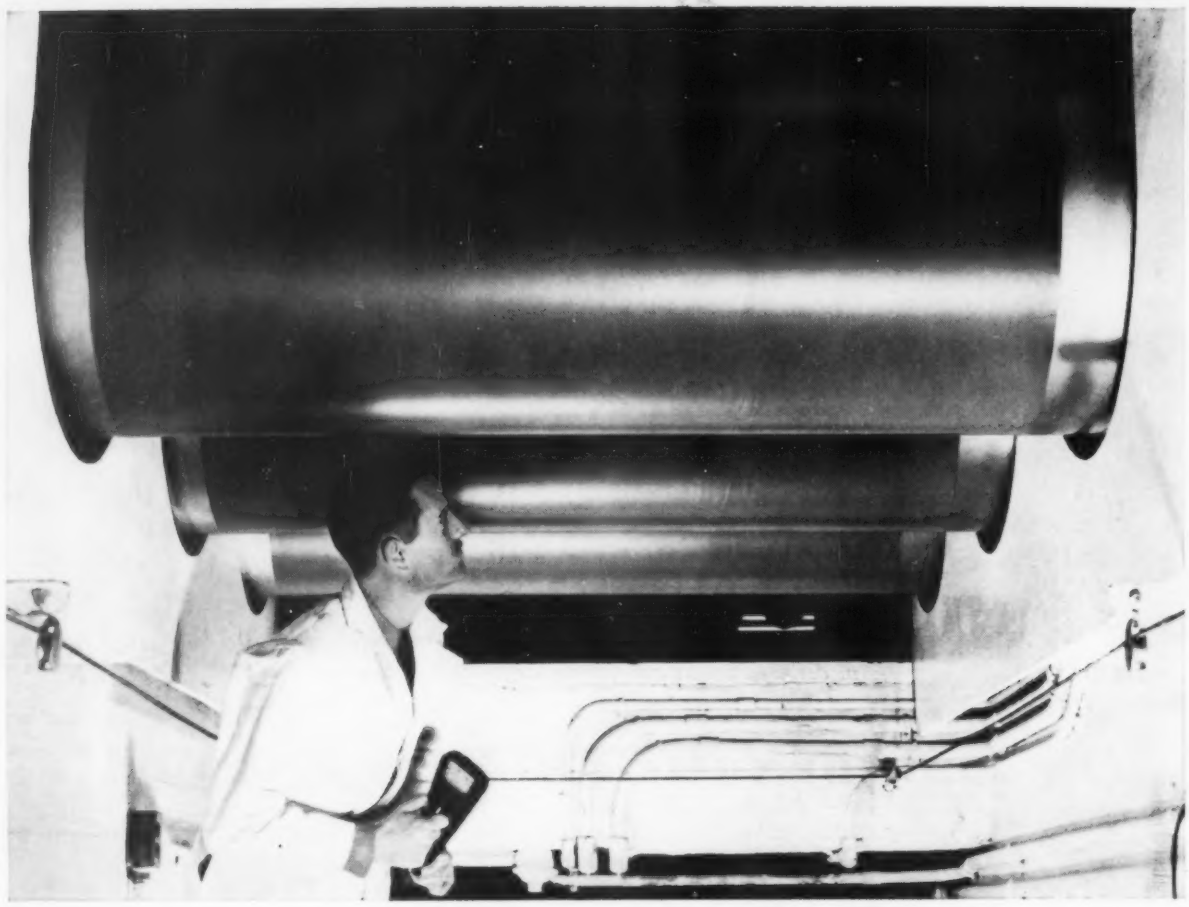

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From film and sheeting to electrical insulation, vinyls come off the machine with "made-to-order" properties when Hercoflex 150 is used as the plasticizer.

Hercoflex 150's demonstrated low-temperature flexibility, as compared against other phthalates, means an important saving on costly supplementary plasticizers.

Hercoflex 150 also retains its high dielectric strength despite exposure to high temperature. The broad range of useful temperatures possible when vinyls are plasticized with Hercoflex 150 makes this plasticizer ideal for extruded wire coatings and cable-jacket stock.

Write for additional technical data on any of the Hercules vinyl plasticizers.

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200 (di-iso-octyl phthalate)
290 (di-n-octyl, decyl adipate)

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FORMAT* — A mechanically bound, all-purpose mat which can be used to advantage in almost all the ordinary applications a molder is likely to encounter.

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FABMAT* — A base layer of woven or unwoven glass cloth or ROVCLOTH* to which a controlled blend of chopped roving is mechanically attached.

ROVCLOTH* (woven roving) — Various weaves available made from 12 to 60 end roving with square yard weights from 12.5 oz. to 48 oz. Custom weaves for specific requirements also offered.

GLASS CLOTH — Custom engineered fabrics with any finishes desired, in widths up to 144″.

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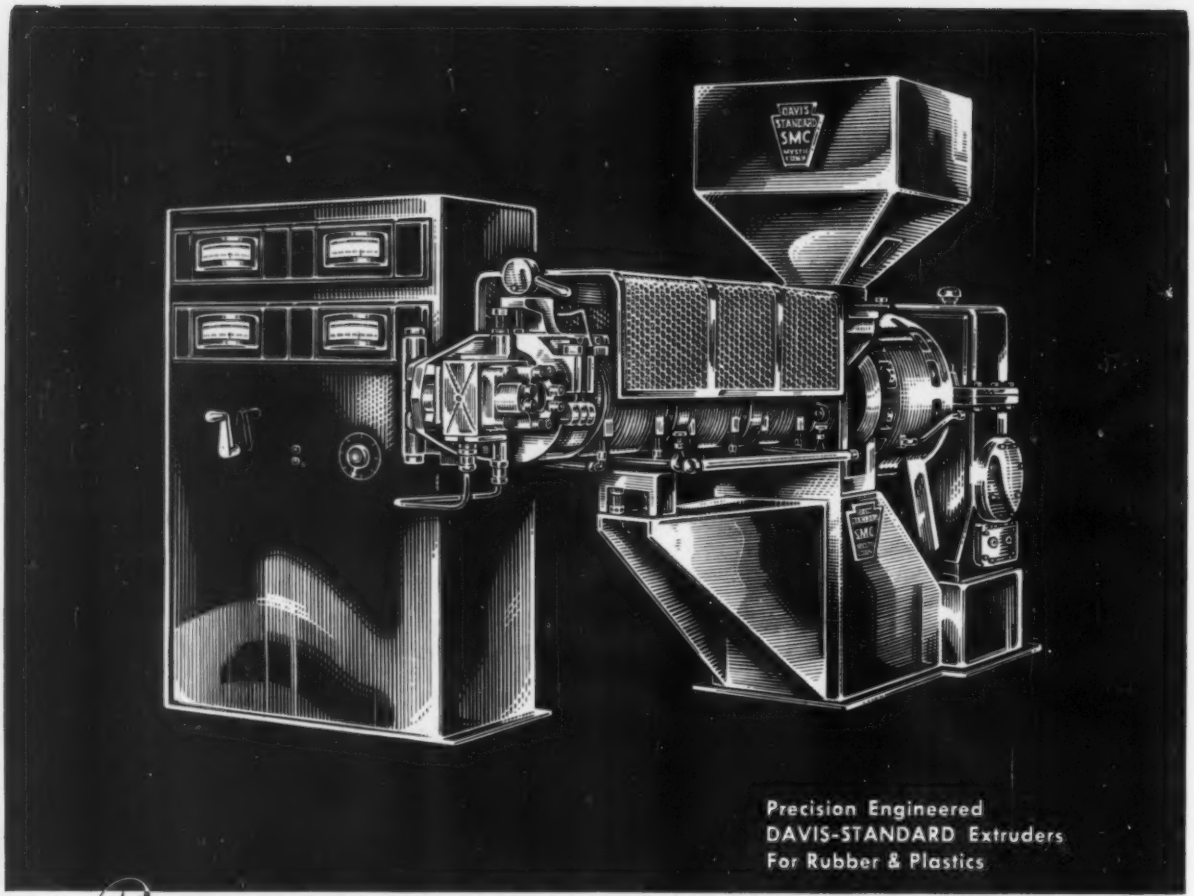

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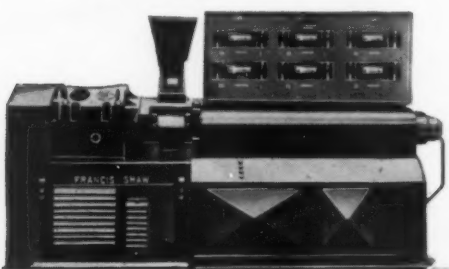

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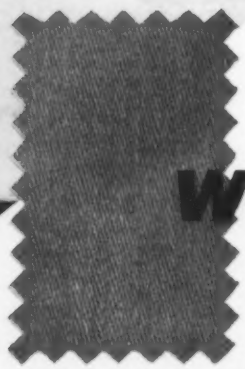
FABRIC is the inside story of the beautiful '55 Ford

Ford's new V-8s offer substantial power increase, "Trigger-Torque" performance, fashion interiors

Ford for '55 is a mechanized marvel. But today it takes more than a fine engine to power a sale. It takes styling—outside and inside.

That is why Ford's new inside story is one of captivating color and texture—tribute to fabrics and coatings exactingly chosen and tested. Vinyl-coated seat tops and trim demanded one type of fabric, headlinings quite another. Arm rests and door panels offered individual backing problems. We are proud that Wellington Sears fabric diversity—ranging from heavy-duty sateens, drills and sheetings to resilient knit backings, smooth spun rayons, and our unique, supple "Lantuck"® non-woven fabric—helped put Ford on the road.

Today, Wellington Sears supplies fabrics for all the major automotive firms and has been blueprinting fabrics for industrial progress for over a century. Why not get the full story as it relates to your coating or laminating problem from our nearest sales office?



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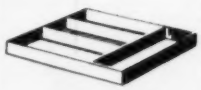
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CHAIRS

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ELMES REINFORCED PLASTICS MOLDING PRESSES

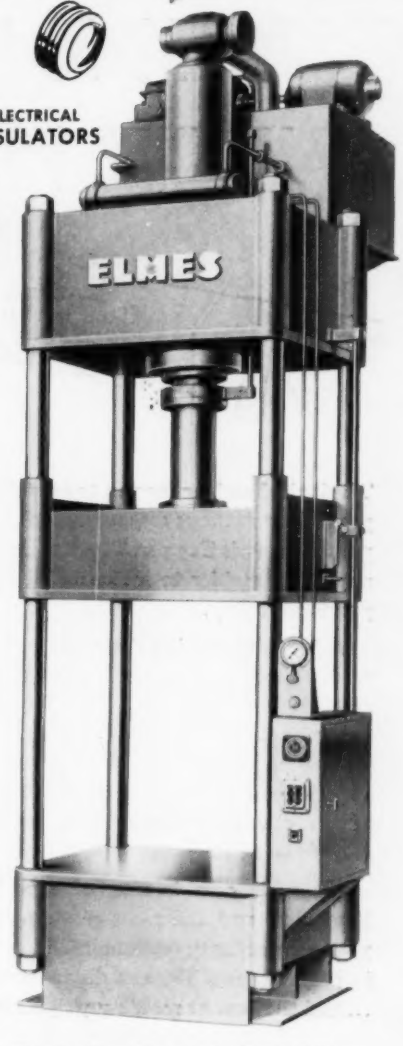
"Deliver the Goods!"

You can depend upon Elmes® Reinforced Plastics Molding Presses to meet your needs *exactly* and at *lowest* production cost. They're "built that way". . . *Elmes-engineered* to fit the job . . . simple and easy to use . . . fast, flexible, and economical to operate.

Following are a few of the outstanding construction and operating features of these presses, specifically designed for the molding of reinforced plastics:

- **Presses are self-contained units,** ready for operation when supplied with hydraulic fluid and connected to your power source. Installation costs are low.
- **Semi-automatic operation.** Press is equipped with push-button controls, including adjustable timer which automatically regulates length of cure cycle.
- **50% pullback capacity** provides ample stripping tonnage for all sizes and types of moldings.
- **Pressing and stripping speeds,** regulated by floor-level controls, are **fully and independently adjustable.** Operator can adjust speeds from maximum to approximately 0″ per minute.
- **Daylight opening adjustment** is made by changing a spacer between ram and platen—much simpler than making threaded column adjustments.
- **Extra-long platen guides** assure accuracy of finished part by maintaining parallelism of platen and base.

Complete details on these and other Elmes Hydraulic Presses for plastics molding will be gladly supplied on request. See your authorized Elmes Distributor, or write to us direct.



Shown above is a standard model Elmes Hydraulic Press specifically designed for the molding of reinforced plastics. Standard models are available in a wide range of capacities and bed sizes, starting at 50 tons. Or—if you require a *special type* press—Elmes engineers will work step by step with you to develop custom-built equipment suited to your needs.

ELMES

AMERICAN STEEL FOUNDRIES • ELMES ENGINEERING DIVISION
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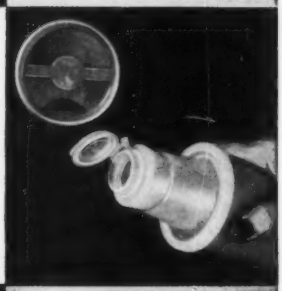
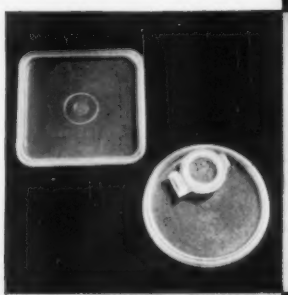
HYDRAULIC PRESSES & EQUIPMENT

METAL-WORKING PRESSES • PLASTICS MOLDING PRESSES • PUMPS • ACCUMULATORS

NOBODY HAS AS MUCH EXPERIENCE AT MOLDING POLYETHYLENE AS TUPPER!





Tupper Seals are air and liquid-tight flexible covers. The famous Pour All and Por Top covers are designed for easy dispensing. They are made in sizes to fit all Tupperware containers.

The logical molder for you to consult regarding that product or package of yours which is to be made of polyethylene is Tupper. Tupper has done more than any other molder to make molded polyethylene a practical reality.

Aside from having designed, patented, and promoted successful seals, closures, and dispensers for polyethylene containers, the Tupper Corporation has vast experience in *every phase* of polyethylene packaging and polyethylene injection molding. This experience will be of major importance in improving your product, in reducing your costs, when Tupper goes to work for you.

Tupper's combination of experience, technical ingenuity, and the most modern equipment is at your service for the custom molding of your product in polyethylene. You can do no better than the best ... and the best at molding polyethylene is Tupper!

When equipped with Tupper Seals, Tupper Canisters, Sauce Dishes, Wonder Bowls, Cereal Bowls and Funnels in various sizes are the most versatile reusable containers you have ever seen.

TUPPER!
TRADE MARK

TUPPER PRODUCTS ARE FULLY PROTECTED

About 150 United States and foreign patents and patents applied for, plus numerous trademarks and copyrights, cover the design and manufacture of the various types of Tupper Seals and other Tupper Products. Unauthorized manufacture of items covered by Tupper patents will subject infringers to prosecution.

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Glass reinforced polyester chair manufactured by the Selig Chair Company. Shell is molded by the Prolon Plastics Division of Pro-phy-lac-tic Company.

Why this chair is made with PARAPLEX P-47

The shell of this smartly-designed modern chair is molded of glass fibers and PARAPLEX P-47 polyester resin. Chair manufacturer and customers alike are pleased with the strength, durability, and beauty which PARAPLEX P-47 provides. The molder of the shell is impressed with the resin's working advantages.

PARAPLEX P-47, when cured, is rigid and tough, yet flexible enough so that squealing does not occur upon flexure. The resin releases readily from hot molds, has high strength and rigidity at elevated temperatures, and has good resistance to cracking and crazing—even in resin-rich areas. Other advantages are fast curing speed and low specific gravity, both of which can mean appreciable cost savings.

For more information on PARAPLEX P-47, and other PARAPLEX resins as well, write Department WW-155.

CHEMICALS FOR INDUSTRY

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. . . for wide range of applications

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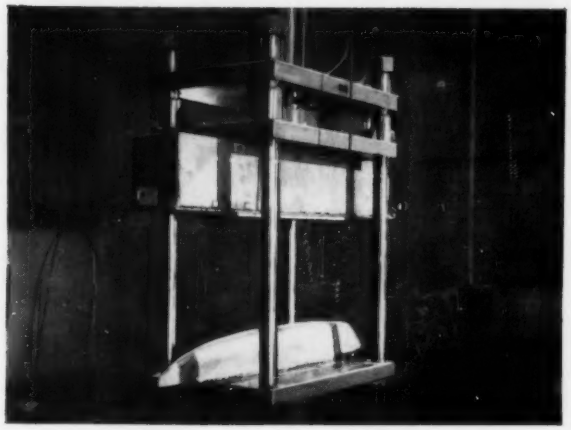
Send today for copy of "Greater Savings Than Ever with C12000's"; also FREE Production Samples! Write: TINNERMAN PRODUCTS, INC., Dept. 12, Box 6688, Cleveland 1, Ohio. *In Canada:* Dominion Fasteners Ltd., Hamilton, Ontario. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *In France:* Aerocessoires Simmonds, S. A. — 7 rue Henri Barbusse, Levallois (Seine).

users report big savings with sprayed metal tooling



Photos courtesy Narmco Mfg. Co., San Diego, Cal.

Typical glass laminated part produced from sprayed metal tooling in press shown. Match molds for this jet aircraft wing tip were built up with alternating layers of sprayed aluminum and bronze over sprayed zinc base and backed with copper tubing, reinforced and insulated with laminated glass cloth. Tubing carries steam for cure, after which cold water is used to chill male for next layup.

new bulletin provides data round-up on current successful applications

Reports from users of sprayed metal tooling on recent successful applications form the basis for a new data bulletin, now available without charge. These case histories demonstrate the substantial savings in time and money over other tooling methods, point up possible pitfalls that can be avoided in tool design and fabrication.

sprayed metal tooling

Data covers general procedures, describes and illustrates tooling now in use and plastic production parts. Write for a copy of this new data bulletin, or use the handy coupon below.

DON A. WATSON
METALLIZING ENGINEERING CO., INC.
1119 Prospect Ave., Westbury, Long Island, N. Y.

Please send me free copy of Bulletin 111 — Sprayed Metal Tooling. No obligation of course.

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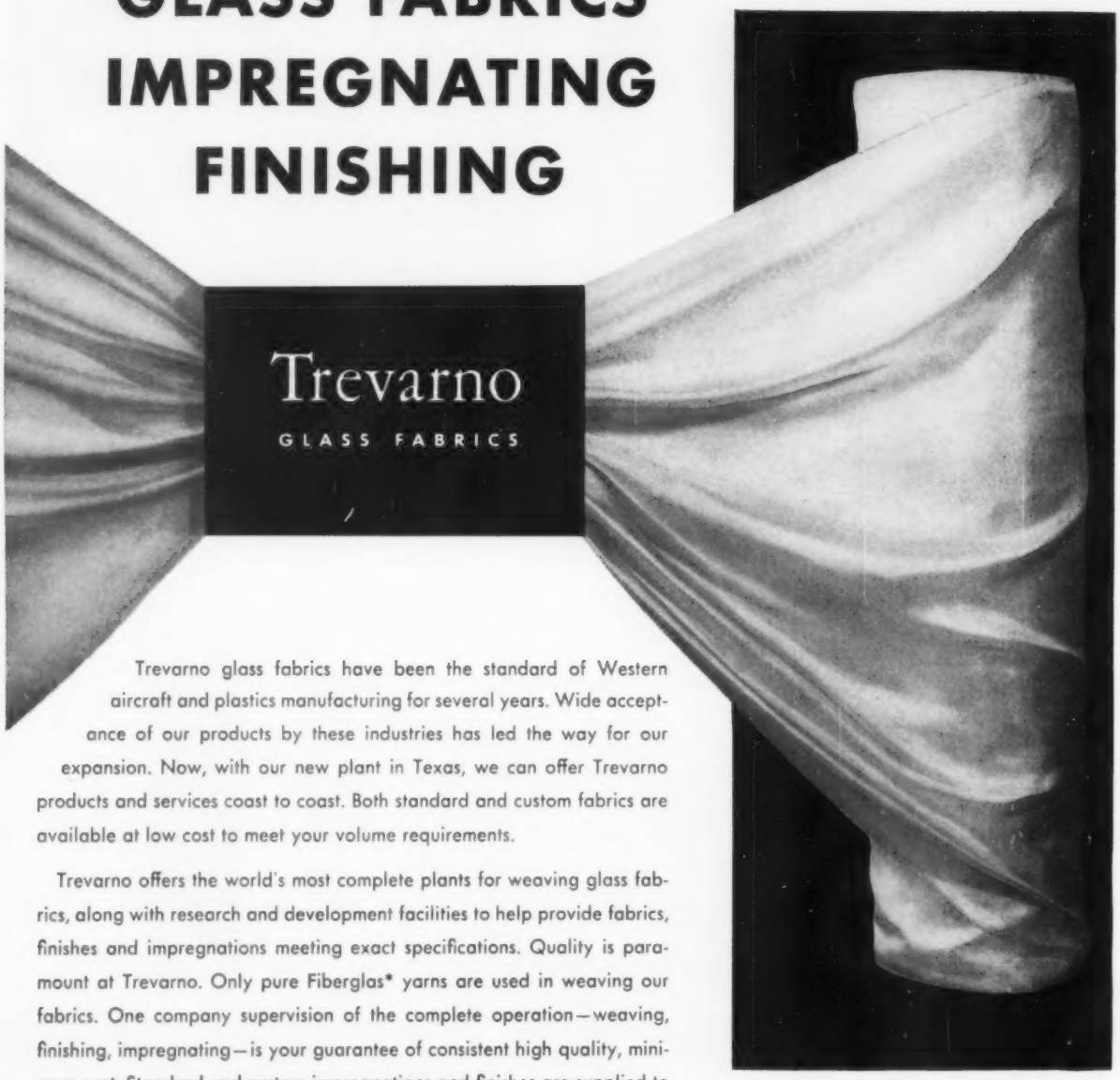

Trevarno glass fabrics have been the standard of Western aircraft and plastics manufacturing for several years. Wide acceptance of our products by these industries has led the way for our expansion. Now, with our new plant in Texas, we can offer Trevarno products and services coast to coast. Both standard and custom fabrics are available at low cost to meet your volume requirements.

Trevarno offers the world's most complete plants for weaving glass fabrics, along with research and development facilities to help provide fabrics, finishes and impregnations meeting exact specifications. Quality is paramount at Trevarno. Only pure Fiberglas* yarns are used in weaving our fabrics. One company supervision of the complete operation—weaving, finishing, impregnating—is your guarantee of consistent high quality, minimum cost. Standard and custom impregnations and finishes are supplied to precision specifications; fabrics are woven to your exact requirements.

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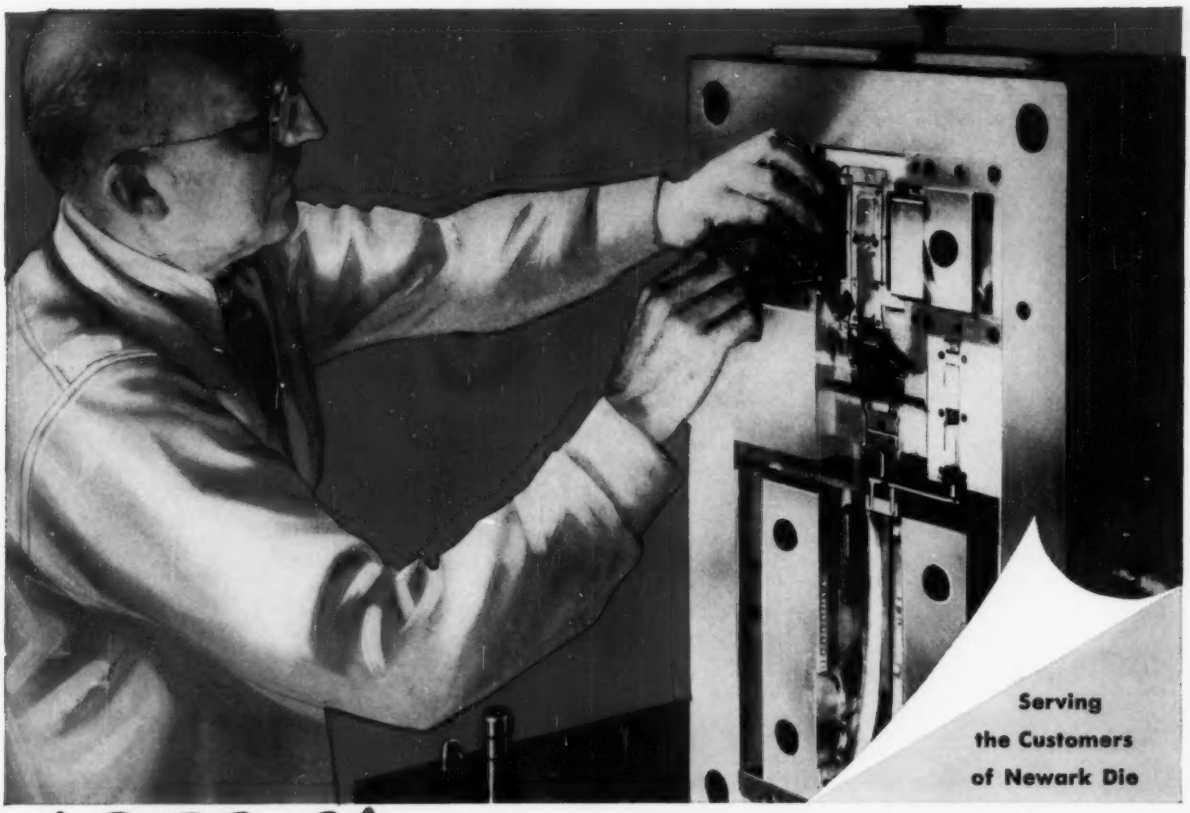

1,259 Years OF ACCUMULATED SKILL* GO INTO MAKING MOLDS LIKE THIS

OVER 50%* OF THE PERSONNEL
of Newark Die have been designing and making precision molds for 15 years or more

Making the plastic *molds* that produce accurately sized plastic *parts* is a job that calls for the specialized knowledge gained *only* through years of experience.

Here at Newark Die, molds are designed by engineers with many a year of experience—built by seasoned craftsmen operating the most modern machine tools. This men-and-machines combination brings you the precision molds that meet your most exacting requirements!

That's the through-the-years story of Newark Die. Just a few months ago, we enlarged and rearranged our mold-making facilities to permit us to serve our customers more promptly—and to maintain and strengthen our position as leaders in the field of precision molds.

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NDC TRADE MARK

INVESTIGATE THE MOSLO LINE BEFORE YOU BUY ANY PLASTIC MOLDING MACHINE

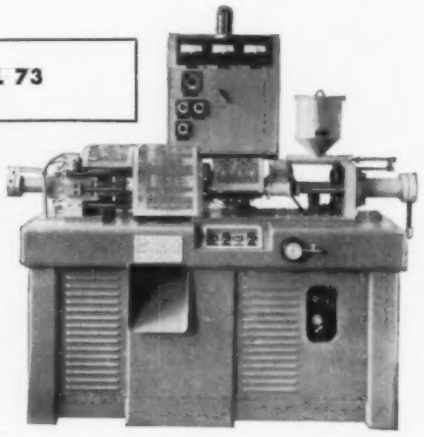
★ **HIGH SPEED** ★ **COMPLETELY AUTOMATIC** ★ **HYDRAULIC OPERATED**

Here is your answer to high-speed injection molding at a low mold cost. The completely redesigned Moslo line comprises three models: the No. 73, the No. 75, and the No. 80. Each is revolutionary in design—outstanding in performance. These machines are setting new and higher standards of quality production for many types of molding operations. They have the effective controls, rugged construction, reliability and speed that make profitable production possible, year after year, in all lines of the plastic molding industry. Savings extend to materials and mold cost as well as productive time.

A unique feature of the Moslo line is a simple and effective hydraulic system. All hydraulic valves are mounted on a convenient hydraulic manifold which eliminates 60% of the pipe fittings normally used in an injection molding machine. It simplifies maintenance problems and eliminates many potential oil leaks.

Before you buy any plastic molding machine, either fully automatic or hand operated, we urge you to investigate the features of the Moslo line. We invite your inquiry—write for additional information.

MODEL 73



- 2 oz. injection capacity per shot
- 1200 cycles per hour
- 25 lbs. per hr. plus plasticizing capacity
- Molds 20 square inches of area plus
- Material hopper capacity—40 lbs.
- Mold opening 6"

MODEL 75

- 3 oz. injection capacity per shot
- 740 cycles per hour
- 50 lbs. per hr. plasticizing capacity
- Molds 40 square in. of area
- 50 lbs. capacity of material hopper
- Deep draw at high speeds

This machine is available with mold arrangement and cycle to fit requirements of mold opening from 8 to 16 inches.

MODEL 80

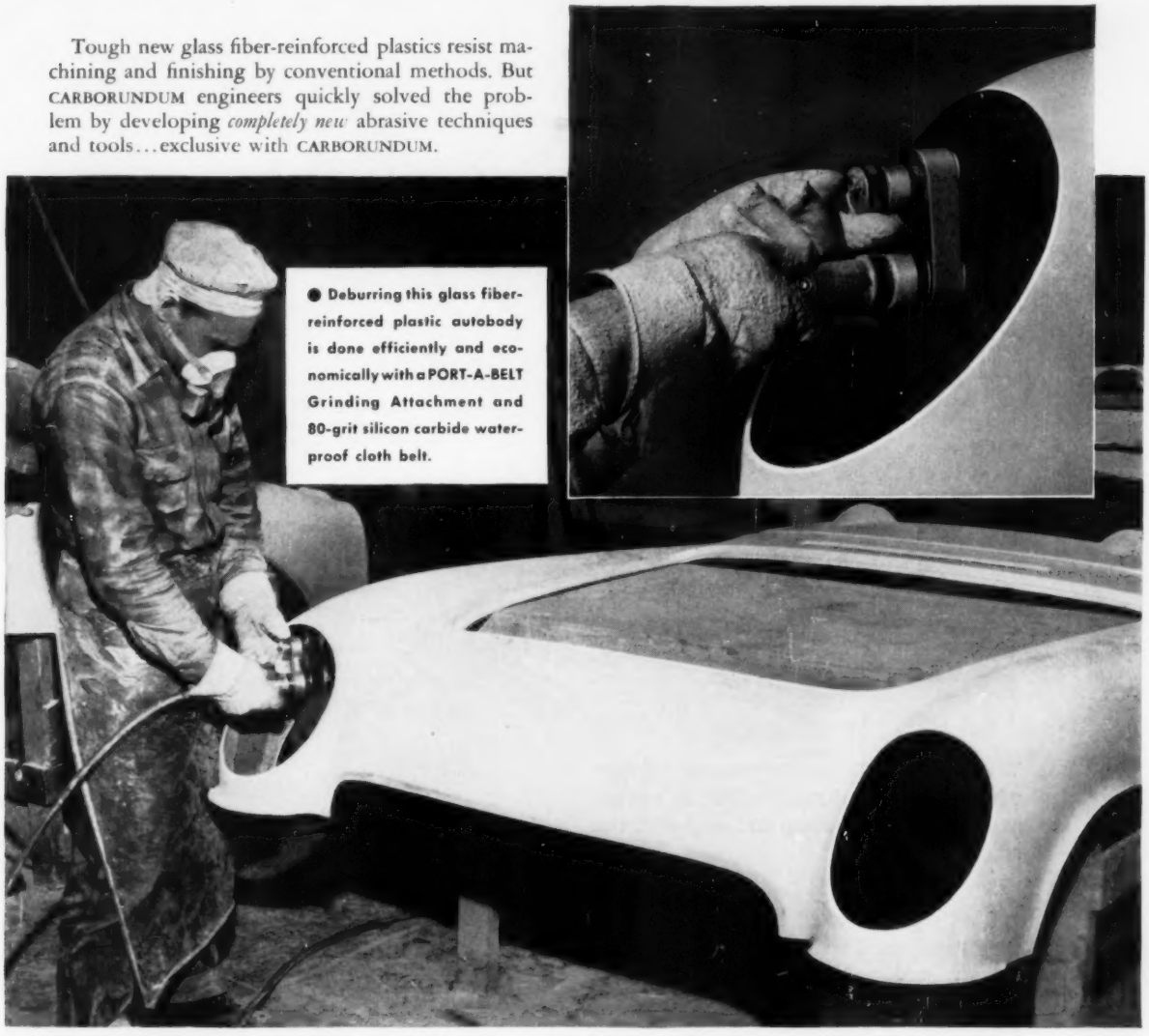
- 4 plus oz. injection capacity per shot
- 780 cycles per hour (dry run)
- 75 lbs. per hr. plasticizing capacity
- Molds 60 sq. inches of area
- 60 lbs. capacity of material hopper
- Mold opening 8"

MOSLO MACHINERY COMPANY

2443 PROSPECT AVENUE • CLEVELAND 15, OHIO

Here's **THE BEST WAY** to grind and finish glass fiber-reinforced **PLASTICS**

Tough new glass fiber-reinforced plastics resist machining and finishing by conventional methods. But CARBORUNDUM engineers quickly solved the problem by developing *completely new* abrasive techniques and tools...exclusive with CARBORUNDUM.



● **Deburring this glass fiber-reinforced plastic autobody is done efficiently and economically with a PORT-A-BELT Grinding Attachment and 80-grit silicon carbide waterproof cloth belt.**

PORT-A-BELT Grinding Attachments and CARBORUNDUM's Abrasive Belts quickly reduce flash, smooth rough edges, remove wrinkles and blemishes. And they're designed for use in hard-to-reach places.

FOR SURFACING larger areas faster and smoother, use the resilient FLEXBAC® Pad Assembly and RED-I-CUT® Waterproof Paper Discs. The flexible rubber pad follows every contour—concave or convex.

CALL YOUR CARBORUNDUM DISTRIBUTOR or salesman today for a demonstration of these abrasive tools specially-designed for use on glass fiber-reinforced plastics. Let CARBORUNDUM's abrasive "know-how" save you time and money.

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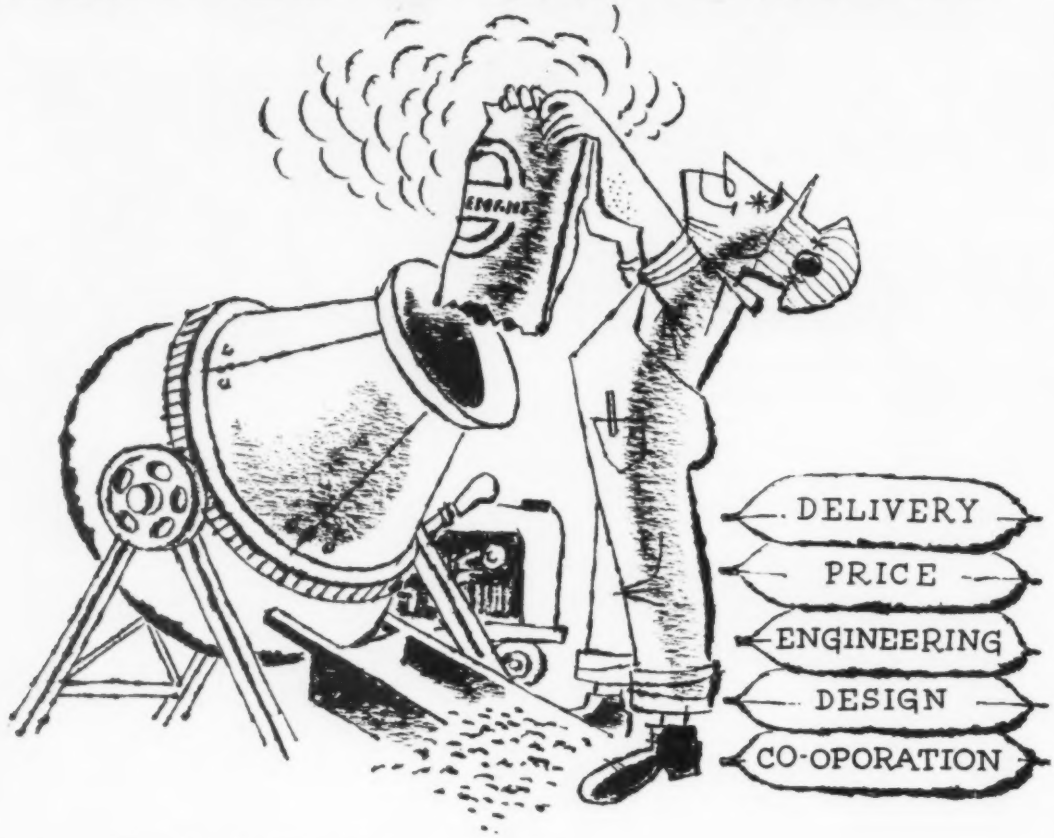
Service is the Cement



What is it that causes a buyer of plastics who has shifted from molder to molder suddenly to settle down and stay with one source of supply?

Cheap prices won't do the trick . . . they rarely add up to more than one disastrous order. Neither will outlandish delivery promises . . . the chance of their being kept is fare for a long-shot bettor. And no buyer who eventually must answer for a shoddy product will fall for let's-get-rich-quick-at-the-consumers'-expense "engineering."

As a qualified expert who can pridefully point to scores of plastics users who come back to us for job after job, Boonton can tell you that the secret cement that holds customers is "service."

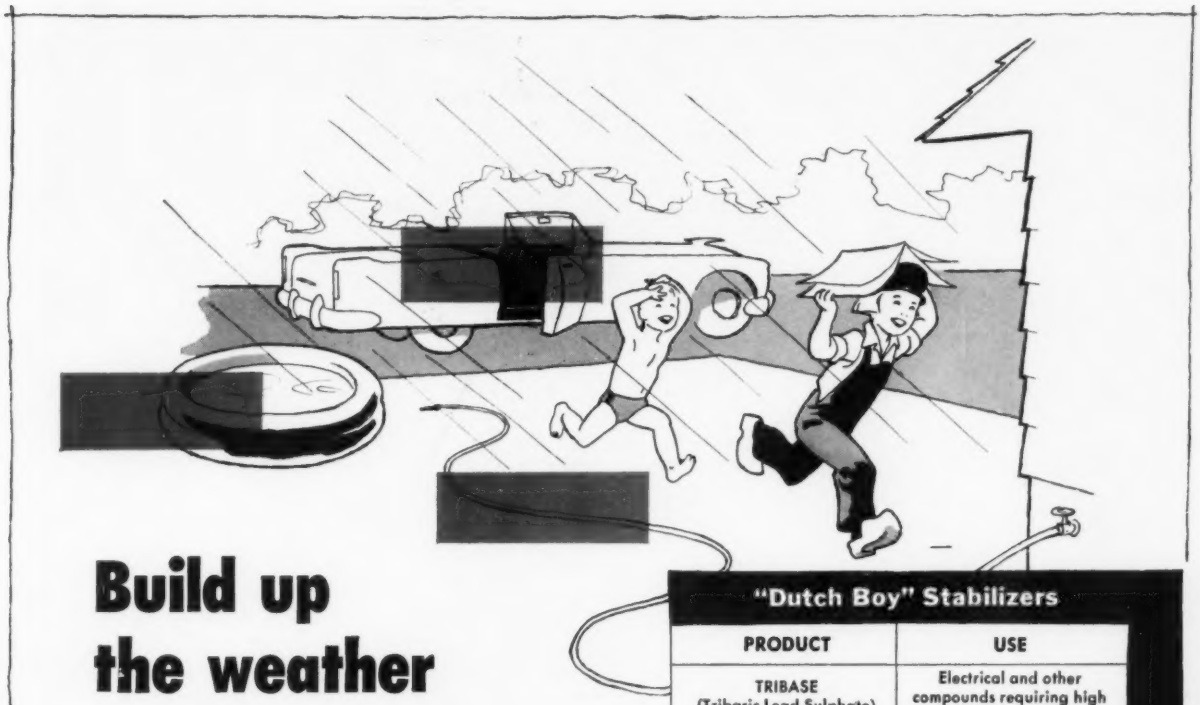
In Boonton's book, a prime aspect of service is top-grade moldings, honestly designed and engineered and honestly priced. Another slant on service concerns itself with getting our ideas on delivery to jibe with the customers', and then rigidly adhering to the stated schedule . . . with plenty of allowance for unanticipated, hell-or-high-water emergencies.

We could continue in this vein for pages more without proving anything conclusively. For conclusive proof that Boonton can transform you into one of our regulars, just give us a chance to show you how our "cement" works next time you need custom compression or injection molding.

BOONTON MOLDING CO.

BOONTON, NEW JERSEY

NEW YORK OFFICE—CHANIN BUILDING, 122 EAST 42ND STREET, OXFORD 7-0155



Build up the weather resistance of your vinyl products

...stabilize with "Dutch Boy" Dyphos

The sun and the rain can be an awful pain to makers of opaque vinyl products.

But not if they are stabilized with "Dutch Boy" Dyphos!

That's because Dyphos gives unequaled light stability. This builds up the weather resistance of your opaque vinyls, gives them excellent color retention, long-lasting flexibility.

Dyphos also imparts excellent heat stability. And this pays off, as you know, in processing.

So, whether you work with plastisols or organosols ... whether your method is slush or conventional molding, extruding, calendering, or coating ... use "Dutch Boy" Dyphos.

Use "Dutch Boy" Plasticizers, too!

Three great, new double-duty primary Plasticizers give you factory pre-balanced low temperature flexibility and low volatility. The newest "Dutch Boy" Plasticizer, NL-A54, is outstanding for economy. "Dutch Boy" Plasticizers of the DOP, DIOP and other standard types give you unusual purity. The "Dutch Boy" Plasticizers team up with the "Dutch Boy" Stabilizers, help reduce cost and simplify processing of vinyls.

For data and technical help on using versatile "Dutch Boy" Stabilizers and Plasticizers, just write.

"Dutch Boy" Stabilizers

PRODUCT	USE
TRIBASE (Tribasic Lead Sulphate)	Electrical and other compounds requiring high heat-stability
TRIBASE E (Basic Lead Silicate Sulphate Complex)	Low volume cost insulation
DS-207 (Dibasic Lead Stearate)	Stabilizer-lubricant for sheeting, film, extrusion and molded compounds
PLUMB-O-SIL A (Co-precipitate of Lead Orthosilicate and Silica Gel)	Translucent and colored sheeting and upholstery stocks
PLUMB-O-SIL B (Co-precipitate of Lead Orthosilicate and Silica Gel)	Translucent and colored film, sheeting, belting
PLUMB-O-SIL C (Co-precipitate of Lead Orthosilicate and Silica Gel)	Highly translucent film and sheeting
DYTHAL (Di-basic Lead Phthalate)	General purpose stabilizer for heat and light. Good electrical properties
DYPHOS (Di-basic Lead Phosphite)	Outstanding for heat and light in all opaque stocks, including plastisols and organosols
NORMASAL (Normal Lead Salicylate)	As stabilizer or co-stabilizer in vinyl flooring and other compounds requiring good light-stability
BARINAC (Barium Ricinoleate)	Stabilizer-lubricant for clears
CALSTAR (Calcium Stearate)	Where non-toxicity and lubricity are required
LEADSTAR (Lead Stearate)	As lubricant and co-stabilizer

Dutch Boy®

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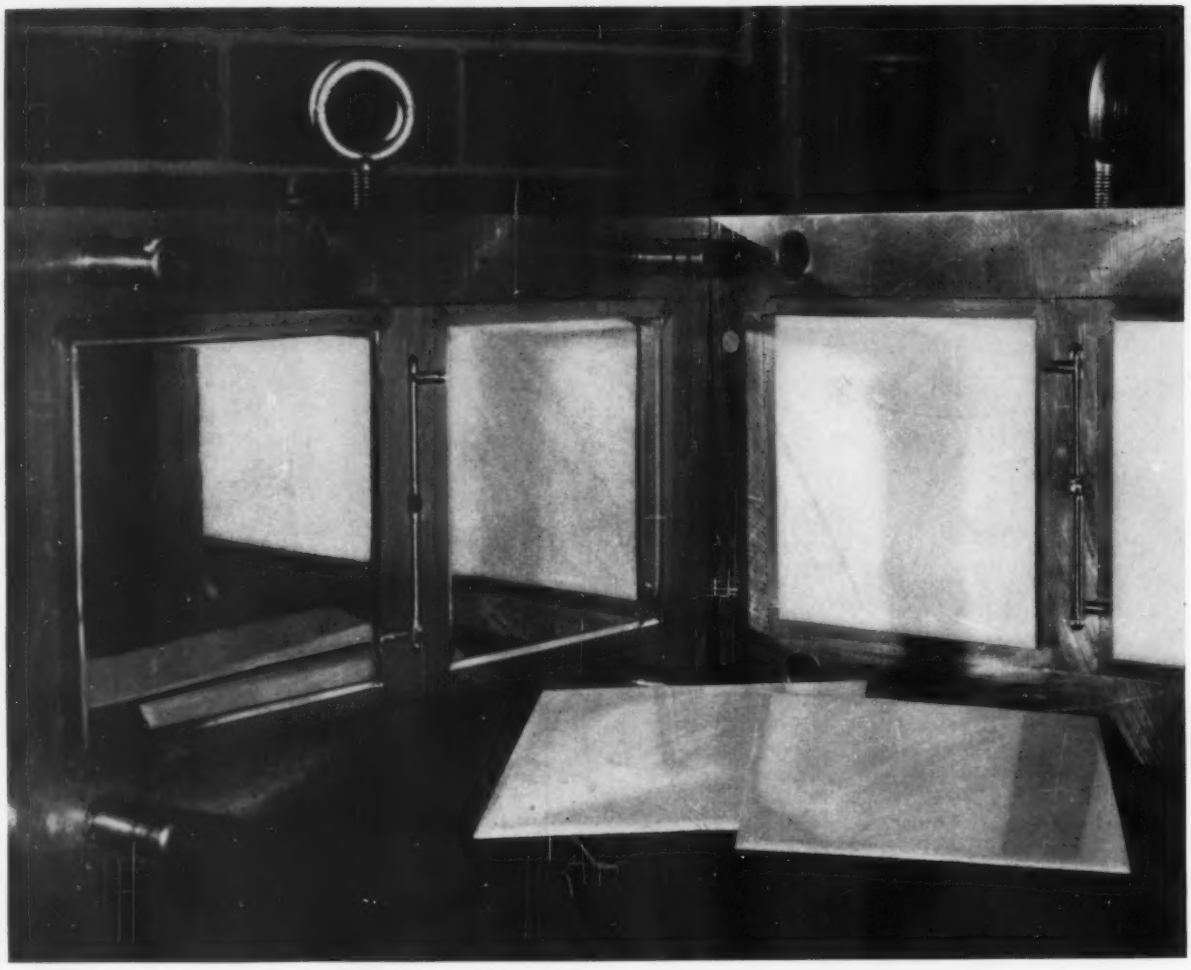

NEW KING-SIZE TILE
Formed with Die of Duramold A

The multiple-cavity die shown above is used by a Midwest manufacturer to produce an attractive king-size plastic wall tile.

Samples of the tile, 8½-in. sq, are shown in the foreground. In the background at left is the two-cavity die, and at right the male die, with tiles over the impressions. This die, made of Duramold A and producing 1320 pieces per shift, had been in operation a full year before major redressing was required.

Bethlehem Duramold A is an ideal tool steel for plastic molding because of its ease of hobbing, and high core-strength (more than 140,000 psi). It offers minimum size-change in heat-treatment because of its air-quenching characteristic. It is also free from surface imperfections, because its alloy content helps to produce a brightly polished surface that is virtually mirror-like. It's a sound steel, free from injurious, pinpoint porosity—a steel you can always count on for outstanding performance.

Duramold A is a low-carbon, 4½ pct chromium-type of air-hardening, electric-furnace steel. It is annealed to a softness of 109 max Brinell, and can be cold-hobbed easily, even where relatively deep or large cavities are necessary.

TYPICAL ANALYSIS

Carbon 0.07 Manganese 0.40
Silicon 0.25 Chromium 4.50
Molybdenum 0.45

Full information about Duramold A, or any of Bethlehem's other steels for hobs, machined cavity dies and master hobs, may be obtained from the Bethlehem office nearest you.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM TOOL STEELS

BETHLEHEM STEEL

Our photograph shows the Vickers-Armstrong 'Viscount', one of the latest British aircraft which has been ordered by leading airline Companies in North America, Australia and other countries throughout the world.

'PERSPEX' on top

'Perspex' is the acrylic sheet specified for British civil and military aircraft supplied to the R.A.F., Commonwealth and N.A.T.O. Air Forces, and to international airline operators. It has withstood the test of time in aircraft operating at all heights in all parts of the world and this proven material is now naturally preferred for the latest forms of air transport. Clear 'Perspex' acrylic sheet is used for windows and the opal and coloured grades are used for lighting fittings, window framings, panelling and other decorative fitments.

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

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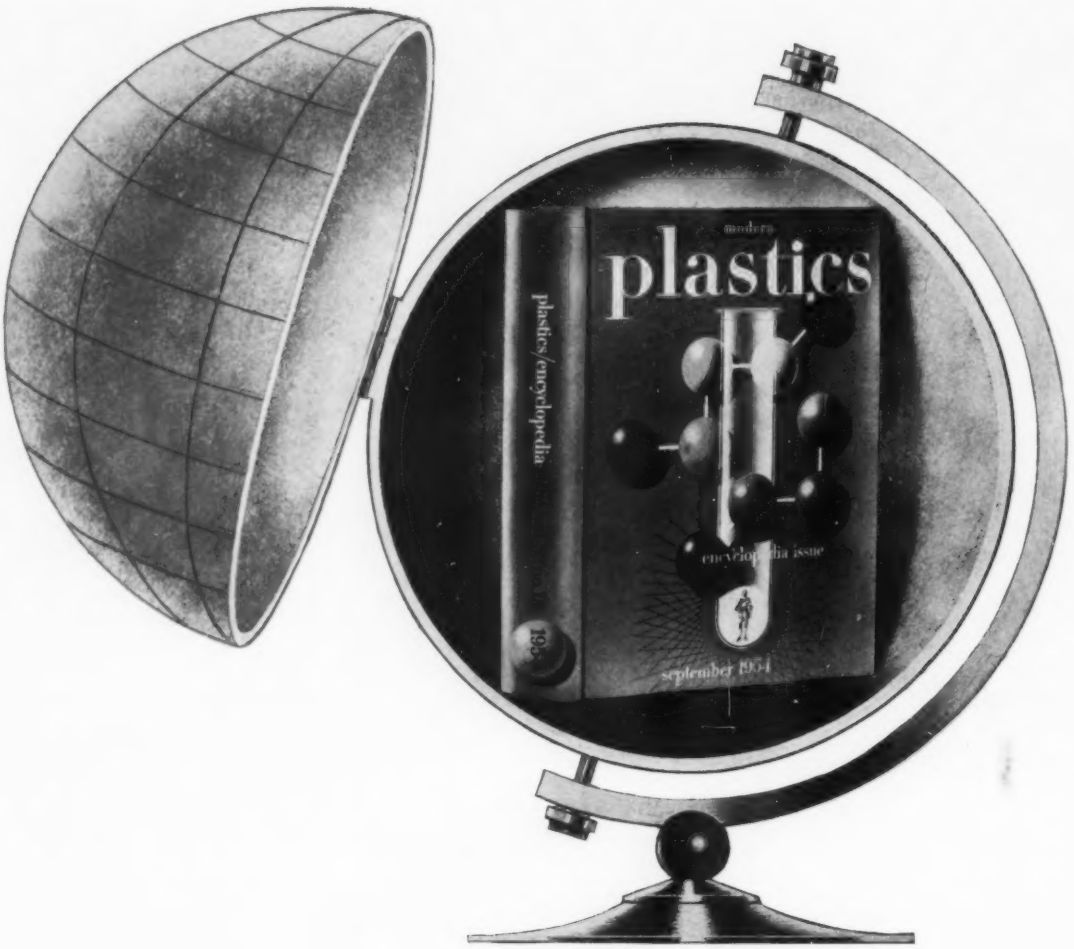

The World of Plastics is at Your Fingertips

with the 1954 Modern Plastics Encyclopedia

What are you looking for? Is it a machine? A plastic material? Is it information about a method of processing a plastic? Or the name of a custom molder who can produce fine moldings for you?

In all probability, exactly what you are seeking can be found in your copy of the data-filled MODERN PLASTICS ENCYCLOPEDIA ISSUE.

The 956-pages of the Encyclopedia are arranged and cross-indexed for easy reference. A large quantity of informative advertising plus an extensive Directory Section of suppliers of materials, equipment, and services guide you to qualified sources for all your requirements.

It's handy! It's helpful! It will be to your advantage to get acquainted with the MODERN PLASTICS ENCYCLOPEDIA ISSUE. Like other users, you will find it to be one of the most useful reference works you own.

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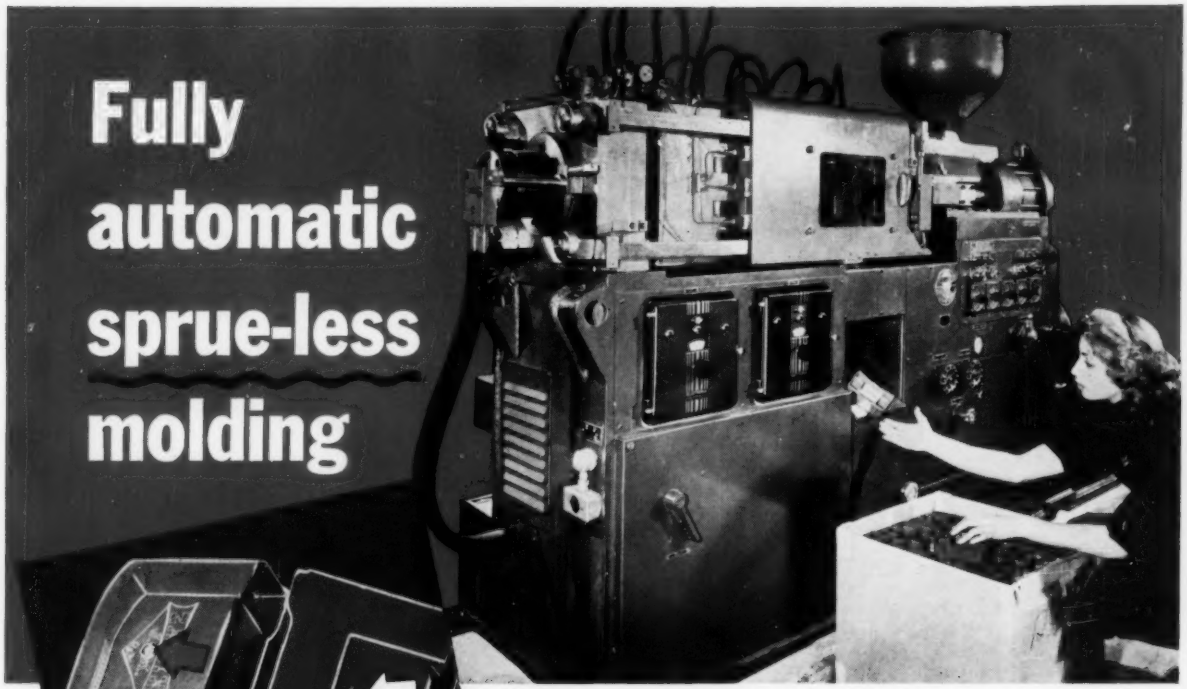
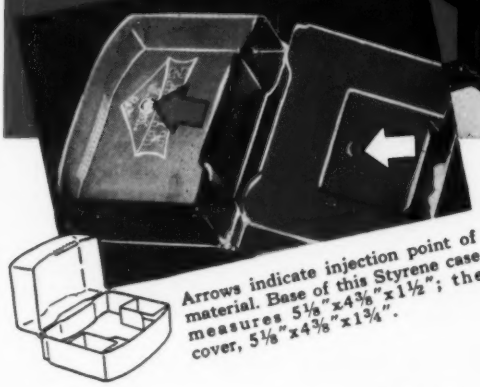
575 Madison Avenue, New York 22, N. Y.

Fully automatic sprue-less molding





Arrows indicate injection point of material. Base of this Styrene case measures 5⅛"x4⅜"x1½"; the cover, 5⅛"x4⅜"x1¾".

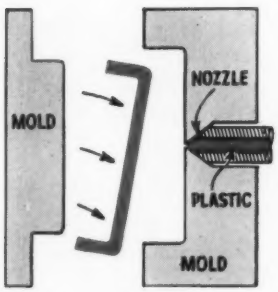
with Fellows Model 1B-3-15 keeps costs down for J. & M. Zadiix Products Co.

Here's how J. & M. "Zadiix" Products Company, Brooklyn, New York licked the problem of economically producing a combination Styrene case for 35mm. color viewer and slides.

They decided upon the sprue-less molding technique because it eliminates cutting off the sprue and finishing...eliminates grinding of waste material...speeds the cycle.

They selected the Fellows 1B-3-15 Injection Molding Machine because it provides completely automatic, high-speed production...5 covers per minute...2½ bases. Also, the complete dependability and consistent molding performance of Fellows machines assures them uniformity of product.

Get the full story of "automation" from a Plastics Machine Specialist at any Fellows Office. Write, wire or phone today!



The extended nozzle technique, as shown, is the basis of molding sprue-less, ready-to-assemble products.

Fellows
injection molding equipment

THE FELLOWS GEAR SHAPER COMPANY, Plastics Machine Division, Head Office and Export Department, Springfield, Vermont
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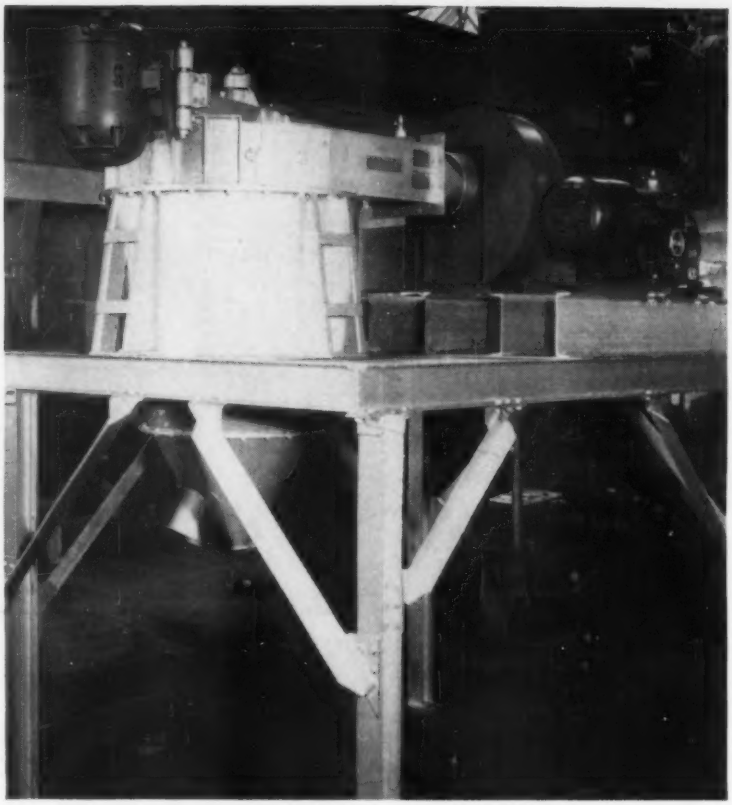
NEW TYPE STURTEVANT AIR SEPARATOR

Recovers Fines in Micron Ranges



Now the famous Sturtevant Whirlwind Air Separator, so widely used throughout industry for fast recovery of fines, has been specially designed to "pick-off" classified materials such as pigments, limestone fillers, plastics, oyster shells, etc., in micron sizes.

These highly efficient air separators select a continuously uniform product of desired fineness. Used in a closed circuit with grinding mills, they increase production, cut power costs.

Large feed opening, rugged construction, ease of adjustment, low power consumption assure economy of operation and minimum upkeep. Write for further information.

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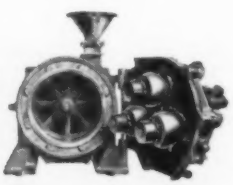
OTHER STURTEVANT EQUIPMENT

MICRONIZER® GRINDING MACHINE
A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired.
Sturtevant Micronizer grinding machines are available in many sizes and capacities.



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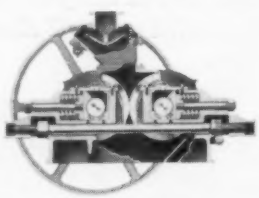
For medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.



CRUSHING ROLLS
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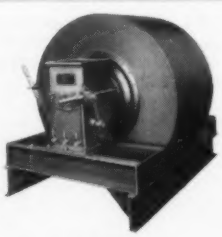

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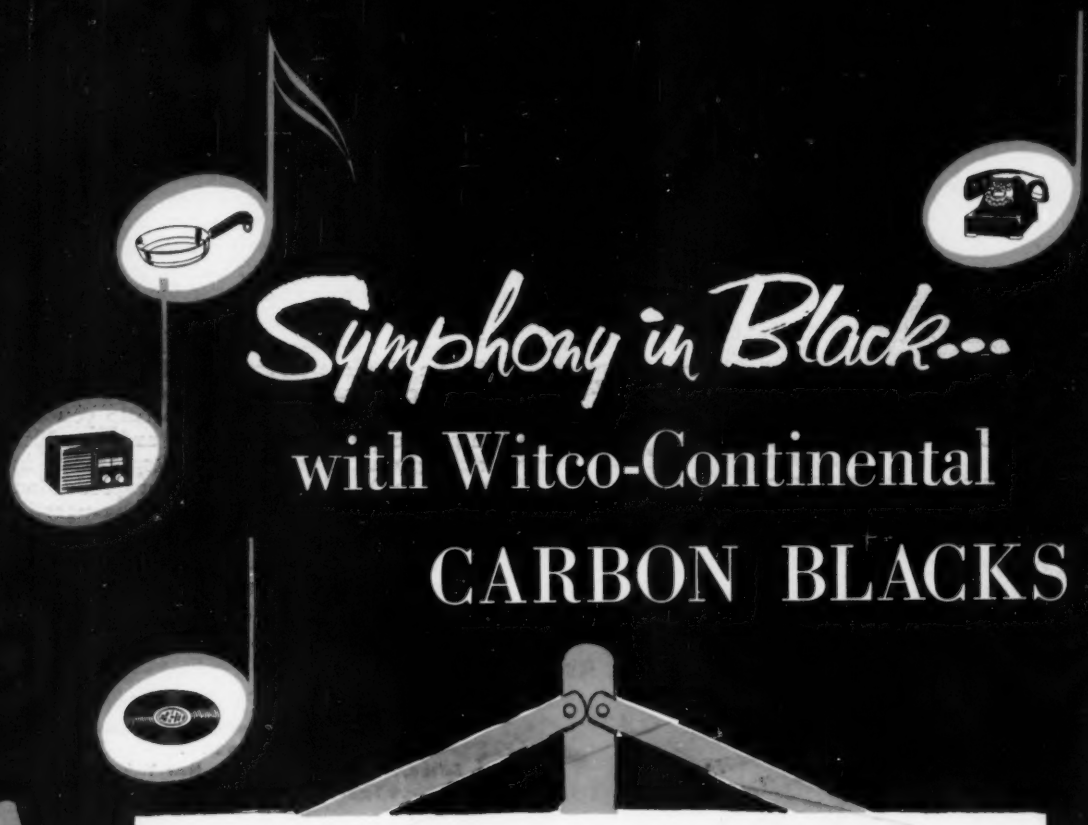

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a new guide to rubber and plastics

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Shown also, are diagrams of production layouts. These setups are developed by the F-B engineering planning division to help you obtain greater processing efficiency, and to reduce handling costs. Extruding machines, matched in capacity with other units so that production proceeds evenly, play an important part in these layouts.

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Gage stays accurate roll after roll
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TO *maintain* accurate gage of plastic film for the length of the roll, roll after roll, the Adamson United Company mounts the rolls of its 36″ x 92″ and 8″ x 16″ 4-roll calenders on Timken® tapered roller bearings. Rolls stay in accurate alignment longer than is possible with sleeve-type bearings.

By holding gage to minimum tolerances, Timken bearings increase yield—allow you to get more yards per pound of material. And because there is no friction between roll neck and bearings, roll neck wear is eliminated. Fewer overhauls are necessary. Downtime is reduced because roll necks don't have to be machined.

The true rolling motion and smooth surface finish of Timken bearings practically eliminates wear within the bearings. Precision is *maintained.*

The gear stand driving the larger calender is also equipped with Timken bearings—a total of 19.

Timken bearings are tapered in construction permitting them to take radial and thrust loads in any combination. And due to line contact between rollers and races, Timken bearings have load-carrying capacity to spare. Get the advantages of Timken bearings in your calenders, mills, refiners, and mixers. For full information, write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

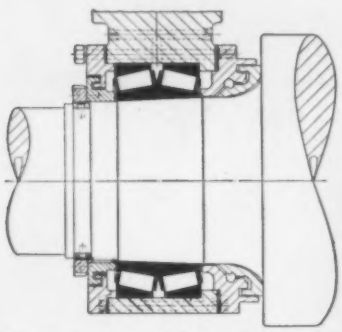
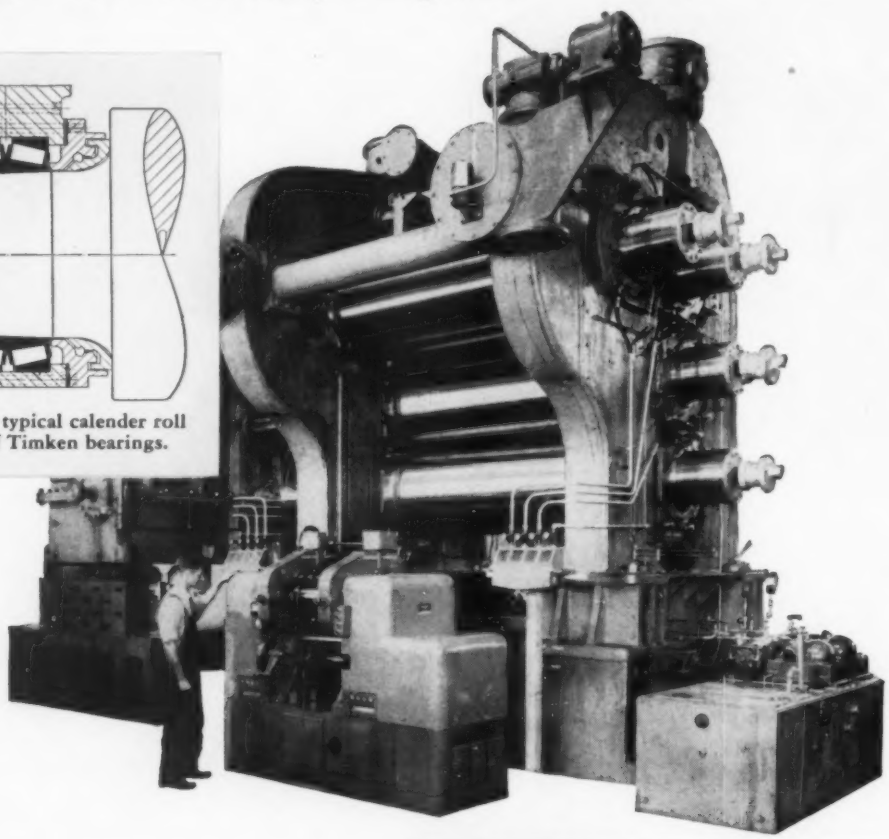
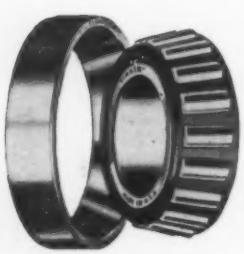


Diagram shows typical calender roll application of Timken bearings.





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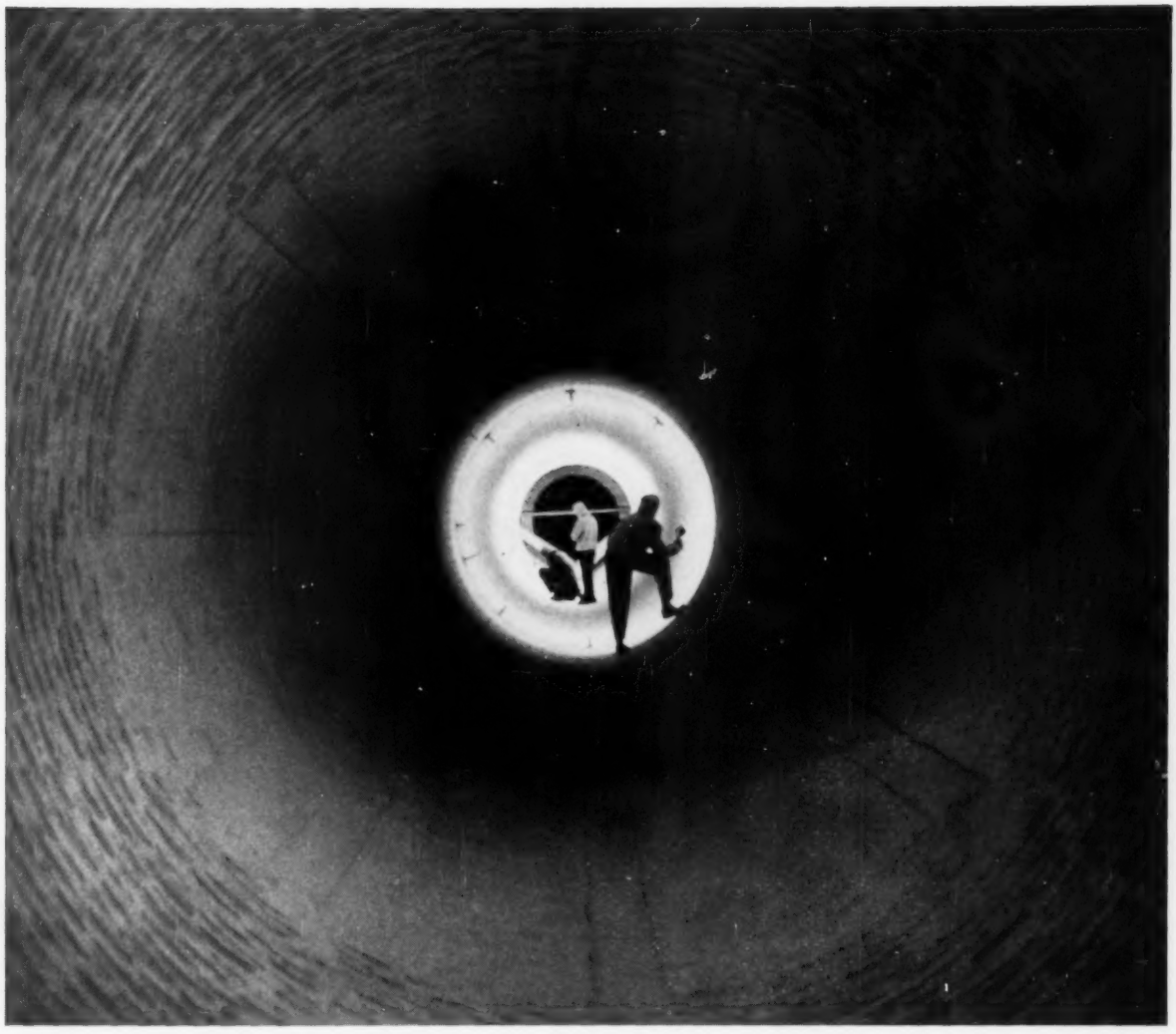

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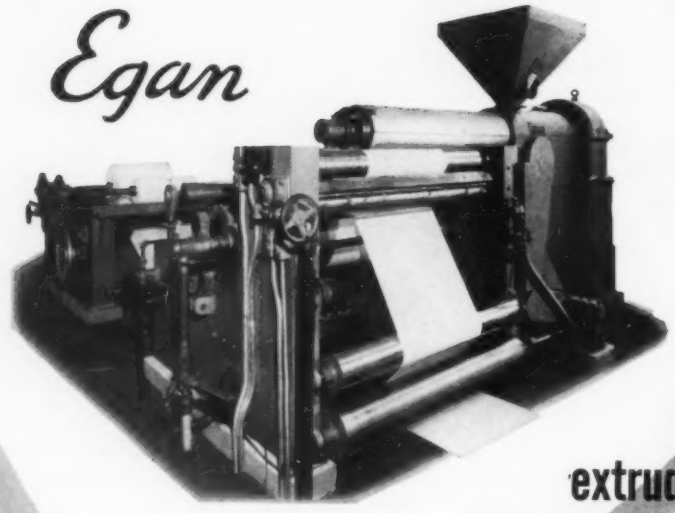

polyethylene extruder-laminator

(Above pictured installation at the Milford, N. J. plant of RIEGEL PAPER CORPORATION)

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Combining in one unit, in engineered balance, two famous units—The Egan Extruder and the Egan Laminator. Planned for your current—or expanding—production, available in varying sizes—from 24" Pilot Plant Size to 96", 1000 feet per minute continuous operation. Machines are capable of coating on paper and paperboard, cellophane, foil, glassine and cloth.

30 **Egan machines now in operation.**

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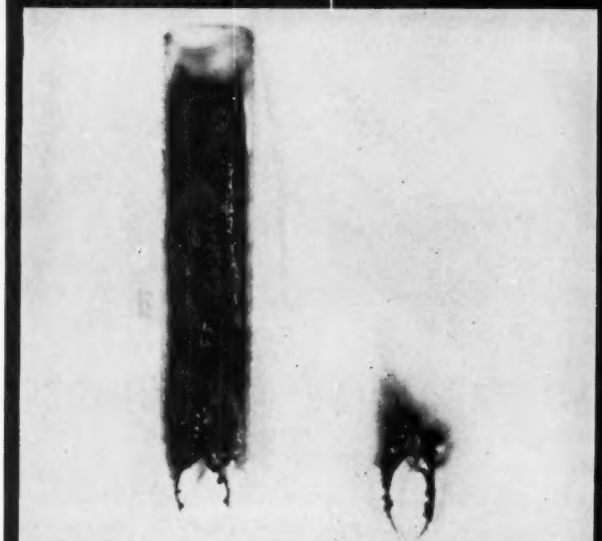
Monsanto Plasticizer News

Flame Retardent...Non-Toxic Good Low Temperature Flex

SANTICIZER 141

FLAME RETARDENT



50 p.h.r. DOP

35 p.h.r. DOP
15 p.h.r. Santicizer 141

S.P.I. FLAMMABILITY TEST on 2 films shows superior flame retardance of vinyl containing Santicizer 141 plasticizer. Enables vinyl garment makers to comply with the 1954 Flammable Fabrics Act.

IN ADDITION—Santicizer 141 offers the same low-temperature flex as DOP, *plus* improved light stability, superior stain and oil resistance, and faster fusion and processing characteristics.

Santicizer: Reg. U. S. Pat. Off.

NON-TOXIC

SANTICIZER 141 has been fully approved by the Bureau of Animal Industry as a nontoxic plasticizer for use in vinyl products such as food containers, wrapping films, beverage tubing, packaging materials, etc., which are intended for contact with food items.

LOW TEMPERATURE FLEX IS EQUIVALENT TO DOP

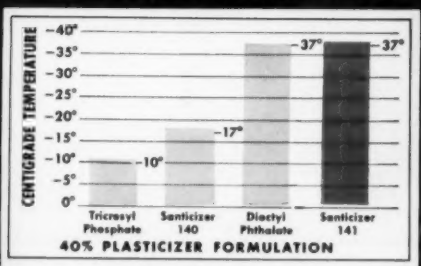


CHART SHOWS the flexibility Santicizer 141 imparts to food wrapping, paper coating, sheeting and film.

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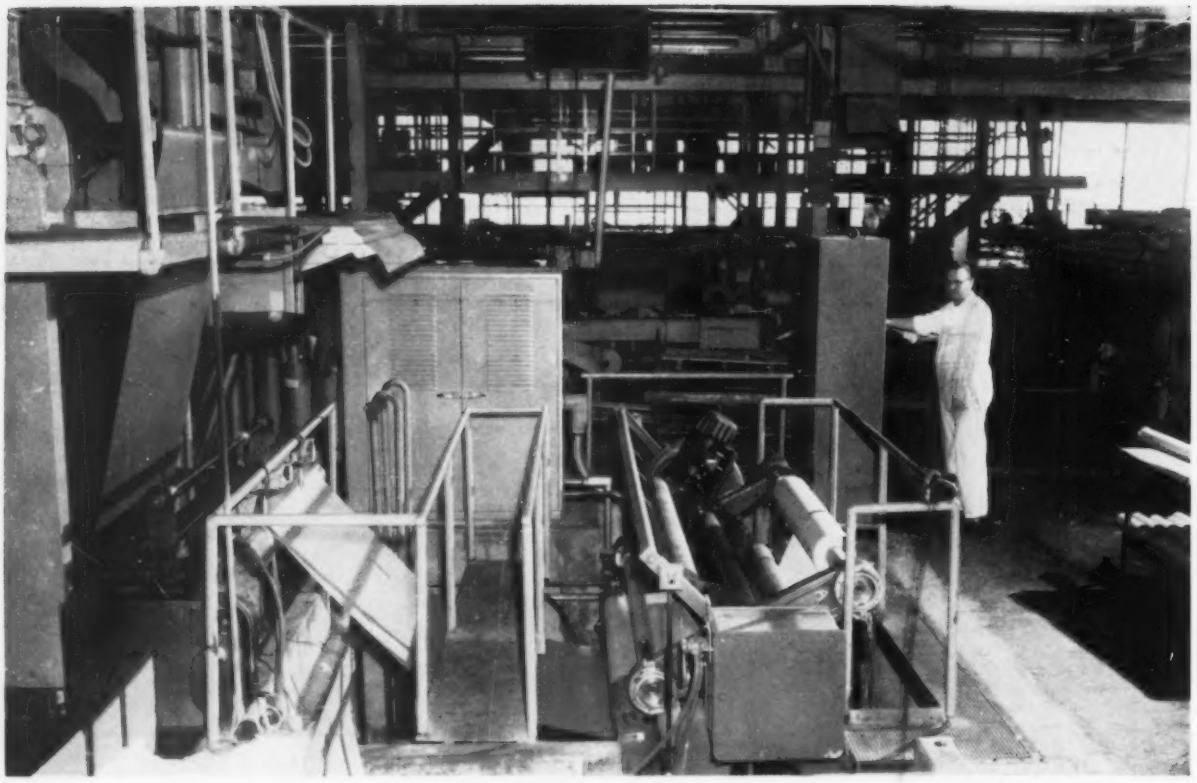
FAST DELIVERY. For delivery when you are in need, Monsanto has bulk shipping stations located in strategic cities from coast to coast.

FOR MORE FACTS on Santicizer 141, write for technical Bulletin: Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478-E, St. Louis, Missouri.

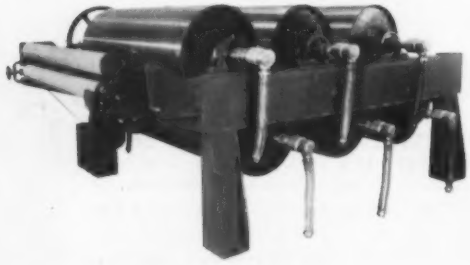


PLASTIC TAKE-OFFS AND WINDERS

Ferristart surface winder for film and sheeting with manual continuous starts on new cores.

This is a Dilts Model 40 2-arm rotating type winder in line with a calender train on production of vinyl film and sheeting. A special dancer roll allows for absolute minimum tension to be held constant over the complete winding cycle. Automatic starts are made without foldbacks or wrinkling. Color movies of this winder in action are available for showing.

Dilts

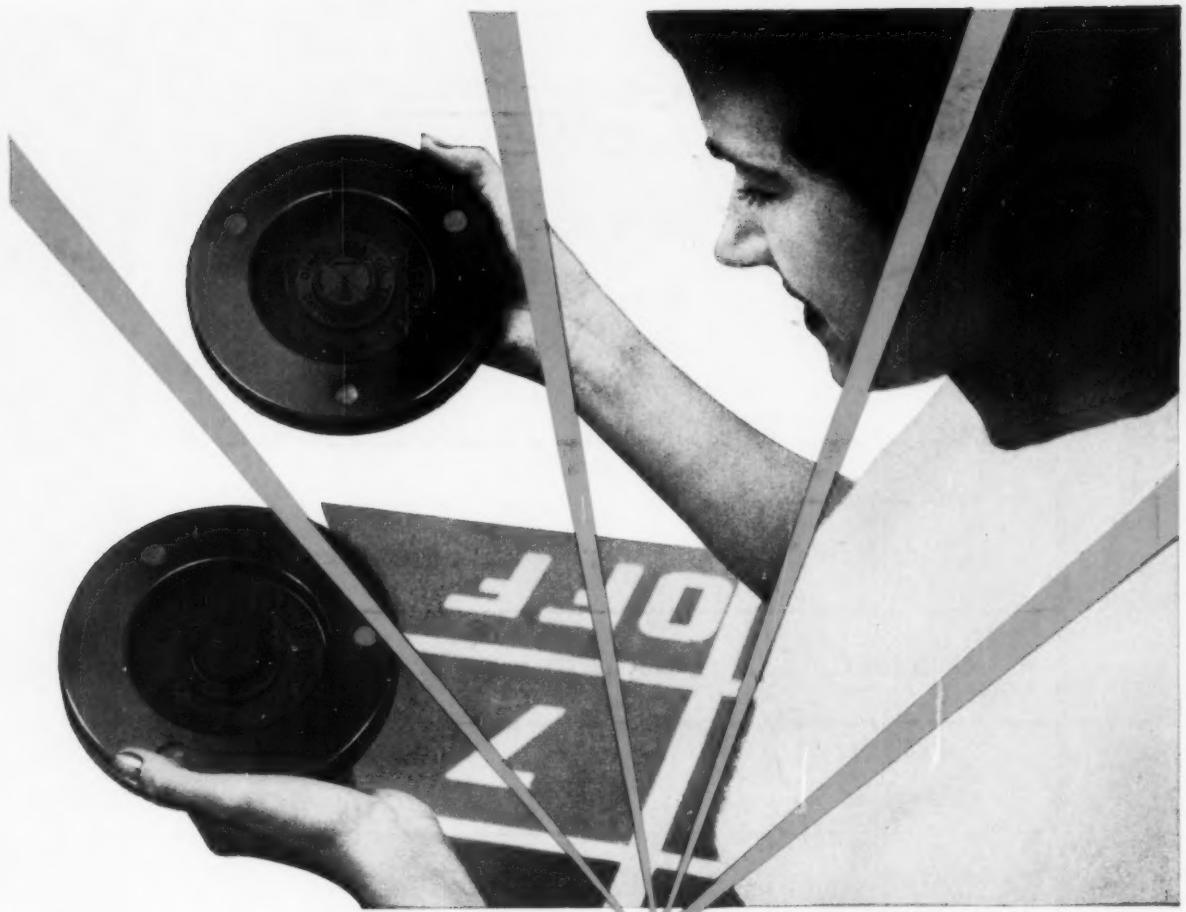


Cooling train for plastic film and sheeting. Double Wall Construction.

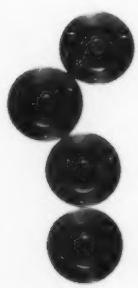
Dilts manufactures complete plastic take-off equipment from calender or extruder to continuous surface or center winders for film and sheeting over a wide range of gages, speeds, tensions, widths and roll diameters.

Write for full information.

THE BLACK-CLAWSON COMPANY
DILTS MACHINE WORKS DIVISION
FULTON, NEW YORK



FUN...WITH IMPACT



Shuffleboard discs must glide smoothly, withstand abrasion and take numerous impacts without chipping. They must also meet precision dimensions and weight tolerances and have the right degree of resilience for proper rebounding during play.

If you had to meet these specifications, you'd look for a material that was tough, molded to a smooth finish and—since the demand was great—insist that it fit the requirements of high speed, mass production methods. Chances are you'd do exactly what Dimco-Gray Company, Dayton, Ohio, did. This leading manufacturer of shuffleboard equipment, after researching various materials, selected Rogers RX-425, a medium-impact phenolic.

And here are the reasons why: RX-425 is tough, yet resilient. It molds to an excellent finish. It withstands repeated shocks. Just as important as the handsomeness of the end product is RX-425's production assets. It can be automatically preformed into hard, volume and weight-controlled pills and either transfer or plunger molded. In fact, it is almost as easy to mold as general purpose phenolics. It's available in colors, too.

When you next need a part that has to be tough and yet easy to produce, specify Rogers RX impact phenolics. You'll get the quality you need at an amazingly low unit cost.

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The Most Versatile LOW-TEMPERATURE *Plasticizers Available*

- *Unmatched Low-Temperature Flexibility*
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- *Excellent Heat & Light Stability*
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- *Extremely Low Soapy-Water Extraction*

Plastoleins 9058 DOZ (di-2-ethylhexyl azelate) and 9057 DIOZ (di-iso-octyl azelate) possess all the properties of a basic plasticizer and...in addition, offer all the advantages of low-temperature flexibility.

This balanced combination of important properties has led to its extensive use in all types of vinyl compounds including calendered and cast films, calendered sheeting, calendered and dispersion coated fabrics, and all types of extruded products.

Why not give your product better performance and extra sales-appeal by using DOZ or DIOZ. Write to Dept. F-2 today for descriptive literature and samples of Plastolein 9058 DOZ (di-2-ethylhexyl azelate) or Plastolein 9057 DIOZ (di-iso-octyl azelate).

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MODERN PLASTICS

FEBRUARY 1955 VOLUME 32 NUMBER 6

Courtesy General Electric Co.

Projected Wonder House of 1964 will be almost all plastics. Roof and exterior wall panels will be of two plastics sheets bonded to foamed phenolic core; inside partitions will be of two layers of decorative laminate separated by light honeycomb; floors will be plastics panels, ducted for air conditioning; interior doors, ceilings, bathtubs, and many other parts will be made of plastics too

Better Buildings ...with Plastics

by ALBERT G. H. DIETZ*

Trends in the construction field toward more prefabrication, more open areas, more curtain and window walls, and more service equipment, offer greater opportunities for plastics

POTENTIALS of plastics in building construction are arousing widespread interest in the plastics industry and among architects, engineers, and builders. Plastics are already widely used in flooring, illumination, upholstery, various types of panels, and such applications as adhesives and protective coatings. And the list of uses is growing constantly. Considerable interest centers on structural and semi-structural applications in which the physical and chemical properties of the various plastics can play an important role.

Building design and construction are developing a number of trends of which the plastics industry should be aware if plastics are to be used intelligently in buildings and if full advantage is to be taken of the

* See portrait and panel, p. 87

Walls, Roofs, Floors

Courtesy Keller Products

Walls of office building are made of plastics sandwiches. First floor panels have reinforced plastics skins, aluminum cores; full length panels have melamine-faced interior, epoxy-phenolic-faced exterior skins

Courtesy Acorn Houses

Completely foldable and portable small house is constructed of sandwich walls, floors, roof, and interior partitions made up of honeycomb cores and plywood faces

building potential. These may be summarized as:

1) Increasing use of shop-fabricated units which can be assembled quickly and economically at the site. Site labor is expensive, and carrying charges during construction are high. Consequently, every effort is made to reduce site labor and time.

2) Open plans, involving large unobstructed clear spans, and allowing maximum flexibility in the arrangement of space by means of non-fixed lightweight movable partitions and screens which can be quickly altered.

3) Open, light-admitting outside walls in the form of continuous strip windows or window-walls. This is accompanied by the trend toward curtain walls affixed to the structural frame in place of heavy traditional wall construction.

4) Greatly increased use and importance of mechanical and electrical equipment, including illumination. Whereas these used to comprise perhaps 10 to 15% of the cost of a building, it is not unusual to find 40% or more of the budget devoted to these items today.

Shop-Fabricated Units

The trend toward shop-fabricated units extends through all phases of building and includes enclosures such as walls, floors, and roofs; mechanical equipment; and the increasing use of built-in fixtures and furnishings of all kinds, especially in residential and commercial buildings.

Curtain walls are finding increasing use in commercial and industrial buildings. Curtain walls frequently consist of panel units largely finished in the shop and assembled rapidly at the site by fastening to the structural frame. In dwelling houses, panelized walls are usually more than curtain walls; they carry the floor and roof loads in addition to acting as curtains. Shop-fabricated panelized floor and roof sections are more commonly employed in dwellings than in commercial and industrial buildings, but even here various types of prefabricated floor structures are employed.

Walls, roofs, and floors have several features in common. They must be strong enough to carry the applied loads, they must have decorative surfaces capable of withstanding weather and wear, and they must be efficient insulators against heat, moisture, and sound. The best panel is one in which all of these features are built-in at the shop so that little or no field work is necessary to achieve the desired ends.

Sandwiches the Answer

Structural sandwiches are the obvious answer to these requirements. By using relatively thin, strong, hard, weather- and wear-resistant facings on lightweight insulating cores, a combination of strength and rigidity is achieved which also serves as thermal insulation and as a water vapor barrier. Acoustical insulation still remains a problem requiring special consideration because hard-surface rigid lightweight panels may be good reflectors and transmitters of sound.

Plastics are finding increasing use in structural sandwiches. High-pressure decorative laminates are attractive as interior faces of such panels and, when formulated with weather-resistant materials, for the exterior faces. Fibrous glass-reinforced plastics perform the same functions. Sheet plastics can be applied over other structural materials, for both interior and exterior surfaces. Resin-impregnated paper faces on plywood and melamine-finished decorative surfaces on structural boards are already employed. Foamed plastics, particularly if unicellular and if inherently resistant to water vapor transmission, should provide heat insulation with minimum condensation hazard. Synthetic resins are the obvious adhesives to bond the parts of the sandwich together. For cores subjected to appreciable stresses, resin-impregnated paper or fabric honeycombs and similar cellular structures are increasingly used.

In any panelized construction, a major problem occurs at the joints. All structural materials expand and contract with temperature changes. Joints, therefore, tend to open in cold weather and squeeze together in hot. Any caulking or gasket must be capable of taking this kind of punishment without mechanical breakdown, without leaking, and without loss of efficiency caused by weathering and aging. The problem still awaits a completely satisfactory solution. Synthetic elastomeric materials may provide an answer.

Illustrations on p. 86 show two buildings employing sandwiches in construction. In one, the wall panels are curtains on a structural frame. The fibrous glass-reinforced plastics light-colored panels on the first floor are translucent; the full-height, dark-colored sandwiches are opaque and have resin-faced structural hardboard faces. In the other, all walls, floors, roofs, and partitions are plywood-faced honeycomb-core structural sandwiches carrying the full load. The entire house can be folded completely and carried away on a truck trailer.

Open Flexible Plans

Open plans permitting maximum flexibility in the arrangement of space are increasingly evident in commercial and industrial buildings, and even in dwellings the trend is quite marked. Such plans require large unobstructed spaces and consequently demand structural forms efficient for long spans. Deep trusses, heavy girders, ribbed slabs, arches, vaults, domes, and space frames all find use. Steel, reinforced concrete, and laminated timber arches are the primary structural materials.

While it is unlikely that plastics will supplant steel, concrete, and laminated timber (in which plastics adhesive are used) for heavy structural elements, there are many ways in which plastics can be used effectively in conjunction with them. Two such applications are suggested:

1) Light-admitting enclosures. In arched and domed roofs, plastics can advantageously be used between the structural elements to enclose the roof and at the same time to admit light. If these plastic elements are themselves formed into arched, vaulted, or domed shapes, they can span considerable distances and, therefore, permit the primary structural members to be spaced farther apart. For example, some of the dome-shaped acrylic skylights widely used today are capable of sustaining loads well in excess of required roof loads. Reinforced plastics can be similarly used.

The readiness with which plastics can be formed into efficient load-carrying shapes should be adapted to a much greater extent than is being done today. Vaulted, domed, corrugated, and other structurally efficient light-admitting roof elements employed with long-span

THE AUTHOR

Dr. Albert G. H. Dietz has been actively concerned with the problems of building construction since 1934, when he accepted an assistantship in the Dept. of Building Engineering and Construction at M.I.T., where he now holds the position of full professor. Recognizing the potentials of plastics as materials of construction he devoted a large part of his work to that phase of the building field. Dr. Dietz is director of the Plastics Research Laboratory at M.I.T., and a member of the following A.S.T.M. Committees: C 19 on Sandwich Construction, D 20 on Plastics, and D 14 on Adhesives. He is also a member of and holds offices in numerous professional and honorary societies

Courtesy Wasco Flashing and Rohm & Haas Co.

Light-Admitting Roofs,

Dome-like acrylic skylights being installed atop roof have structural strength to carry heavy loads without developing heavy stresses

structural elements are among the most promising methods of providing large, clear, well-lighted spaces for industrial and commercial purposes. Much the same type of construction, but on a smaller scale, could be used in dwellings, possibly omitting the primary structural elements altogether.

2) Forms for reinforced concrete. Concrete, formable into almost any desired shape, is not yet used in all possible varieties of structural shapes, largely because of the cost of the necessary forms. Forms for a simple hemispherical dome can easily represent 50% of the entire cost, and when the shapes become more complex the cost of forms becomes prohibitive. Even in floor and roof slabs the familiar rectangular grid pattern is used not because it is particularly efficient structurally but because the forms are cheaper to construct. Ribs radiating from columns would be more effective. Some work of this type done by Nervi in Italy is indicative of the possibilities.

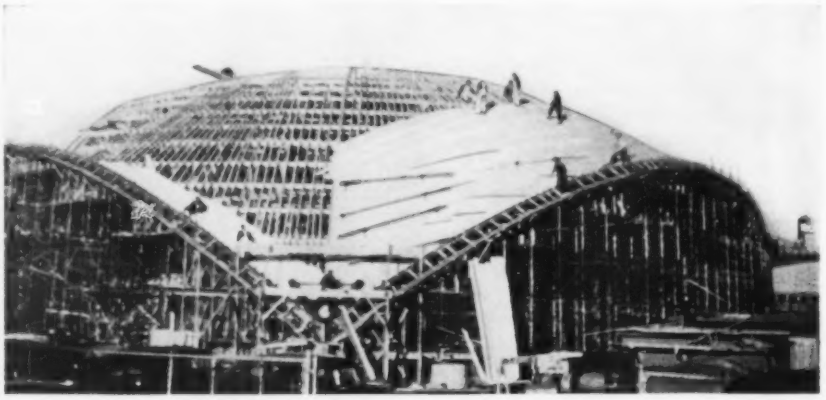
Because plastics can be readily fabricated into practically any desired shape, they can provide a great variety of complex shapes for forming reinforced concrete. Reinforced plastics, for example, have already been proved for use in reinforced concrete forms, and they can be re-used a large number of times. This is the essential feature. Even though the initial cost of plastics forms may be high, the over-all cost becomes lower as re-uses become higher. Forms of this kind can be ideal for such repetitive uses as in the pouring of concrete floor slabs incorporating efficient but intricate ribbed construction, interlocking ribbed vaults and domes, and similar structures.

It is conceivable that concrete forming and permanent light-admitting elements could be combined. Reinforced plastics or other transparent and/or translucent plastics could be used to produce concrete structural elements such as ribs in a roof structure and simultaneously provide the light-admitting roof elements between the structural ribs. This could be particularly economical if the roof consisted of repetitive elements involving a large number of identical plastics parts capable of being made in a single mold, or on simple patterns for vacuum forming.

Open, Light-Admitting Walls

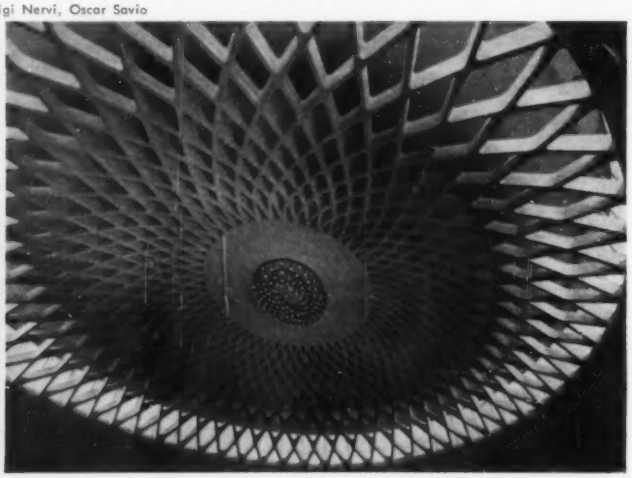
In all types of buildings—commercial, industrial, and dwelling—there is a trend toward a greater degree

Reinforced Concrete Forms



Cost and complexity of forms for reinforced concrete for domical structures has held back use of such shapes; re-usable plastics forms may overcome these difficulties

Photos courtesy Pier Luigi Nervi, Oscar Savio



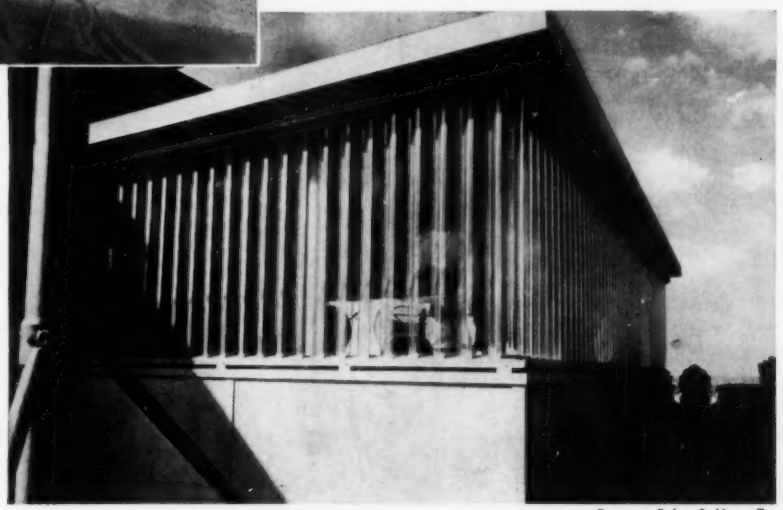
Re-usable reinforced plastics forms are particularly adaptable for such applications as pouring concrete floor slabs that incorporate intricate ribbed construction (left), or for pouring interlocking ribbed vaults and domes, or similar structural shapes (right)

Light-Admitting Walls

Panels in bedroom windows are of fibrous glass-reinforced polyester, provide diffused light

Courtesy U. S. Rubber Co.

Corrugated transparent acrylic sheets, 6 ft. high, provide 500 sq. ft. of continuous glazing around three sides of a television relay station



Courtesy Rohm & Haas Co.

of openness in the outside walls to admit maximum daylight and to provide a feeling of spaciousness. Buildings with all-glass outside walls are becoming increasingly numerous. Curtain walls, including sandwiches, are also being combined with transparent outside walls.

These types of construction demand consideration of such aspects as adequate strength against wind loads, heat gain when the bright sun shines through the wall, outward heat losses, breakage, durability, and weather-tightness. For some of these, transparent and translucent plastics are promising; for others, they have their limitations.

Adequate strength is largely a matter of proper design and can be achieved in plastics or other transparent materials. Inherent heat loss is about the same for transparent plastics and other materials and can be counteracted by using several layers of material, with quiet air between. Plastics are superior from the standpoint of breakage, but poorer in scratch resistance and dimensional stability. Some plastics have good durability and weather resistance but none has the long history of glass. Weather-tightness is largely a question of durable, flexible, weather-tight caulking compounds. The problem is similar to that of providing tight joints in panelized construction.

Solar gain can be a serious problem in large flat transparent walls. Even in winter the bright sun beating through a transparent wall can make the interior of a building uncomfortably warm. Overhanging sunshades, venetian blinds, shades, and heat absorbing glass all help, but are not the complete answer. If transparent surfaces are tilted in such a way as to present a steep angle to the sun's rays, much of the direct radiation from the sun can be reflected outward.

By judiciously shaping the transparent wall surfaces so as to provide high-angle reflection of direct sunlight, the problem of solar gain can be ameliorated. Such shapes might at the same time provide greater strength and, therefore, permit thinner material to be used in large openings. Here the relative ease with which transparent plastics sheets can be shaped recommends them for serious study by designers looking for a combination of enclosure, light transmission, and minimized direct solar radiation. Relatively little has been done in this direction, although corrugations, ribbings, and other shapings have been used in transparent and translucent plastics. Another approach to the problem is being made by reinforced plastics producers through the controlled use of texture and integral color.

Mechanical Equipment

Air conditioning, radiant heating, over-all illumination, and greatly increased electrical power demands contribute to the growing portion of the cost of a building attributable to mechanical equipment. With these increases come the demand for greater flexibility. Electrical power outlets should be available anywhere and if space arrangements are changed by moving partitions, provisions for heating, air conditioning,

Over-all Illumination

Courtesy Luminous Ceilings, Inc.

Corrugated flexible vinyl diffusing panels that provide high light level and cut glare to a minimum are installed by simply unrolling precut strips of the sheeting onto metal tracks suspended below true ceiling

and lighting systems should be flexible enough to conform.

Many ingenious systems of continuous power outlets such as strips along a wall, or numerous outlets set in a floor, have been devised. The flexibility and electrical insulating characteristics of many plastics can contribute to a solution of this problem. Large areas of translucent and transparent plastics are already used for over-all illumination, and this use should increase. Some use has been made of flexible plastics piping buried in floors and ceilings for radiant heating and for cooling. Plastics pipe is in use for cold water lines and may someday be extended for hot water service as well. The serious problem of creep under pressure and at elevated temperatures must be solved if this application is to increase in permanent building installations.

Air-conditioning ducts are large and spread throughout a building. There is no great weight to be carried by such ducts but they must support themselves over reasonable distances without sagging, they must not corrode if some condensation should occur, and they should not convey noise from one part of a building to another. The inertness to corrosion and the damping capacity of plastics might be helpful, but the tendency of some to creep might be a drawback. Where corrosive fumes are to be handled, plastics have distinct advantages. Cost, of course, is a major consideration.

A large radar enclosure of reinforced plastics may serve to illustrate a combined structural function well served by plastics. Rotating radar equipment had to be enclosed in a structure transparent to microwaves. A dome was indicated as being the most efficient shape to enclose the radar and to withstand wind stresses. Metal could not be used. Analysis of wind loading indicated that reinforced plastics could easily meet the requirements. The 36-ft. diameter dome was made in triangular segments with fibrous glass mat-reinforced surfaces and fibrous glass cloth-reinforced ribs. Although it was not essential, translucence was achieved at the same time. Here reinforced plastics provided a combination of structural form, structural strength, enclosure, and light transmission which answered the problem completely. The structure easily withstood the hurricanes of the fall of 1954.

Properties

If plastics are to find widespread use in buildings, they must be applied because of superior properties and not merely as replacements for other materials. Direct substitution is likely to result in an expensive inferior product. Plastics range in strength from soft and weak to

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To Withstand Wind Stresses

Large enclosure for radar installation is made of fibrous glass-reinforced polyester, affords complete protection against the elements to the instruments inside

Expanded Sheet in Garage Door

Reinforced plastics material is molded as single sheets; center is expanded to stress skins and give high rigidity

FIRST mass-produced overhead garage door made chiefly from fibrous glass reinforced polyester plastics was exhibited recently at the National Home Show in Chicago.

The door, a product of Tilt-A-Door Corp., Detroit, Mich., old-line manufacturer of sheet metal doors, has many advantages. First, it comes in a range of translucent colors so that a selection can be made which will harmonize with the rest of the building. Second, it permits the interior of the garage to be illuminated without windows and with no sacrifice of privacy. Third, since the material has molded-in color, no painting is required and cleaning is easy. Fourth, the well-known impact strength of reinforced polyester allows the door to stand up under blows from basketballs, baseballs, and tool handles.

Expanded Sheet

Secret of the door's construction is the use of panels of "expanded Tropiglass," a patented product of Russell Reinforced Plastics Corp., Lindenhurst, New York. These panels are single-molded units which are literally single sheets at the edges and two sheets at the centers, with an expander through the center air space.

The expanded sheets are made by laying glass mat on a press caul, applying the polyester resin, and laying narrow strips of cellophane or Teflon over the area where the air space will be required; then another layer of glass mat is laid down on top of the first and sufficient additional resin applied to make the product; the whole loaded caul is then placed in the press. The result is a flat "air sandwich" which, when expanded with the aluminum rod or tube, puts the skin on either side of the sheet under stress and gives the sheet high rigidity and torsional strength.

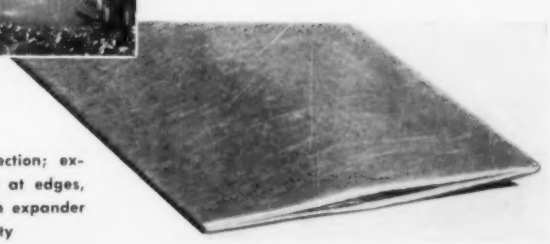
In the first models of the new door, standard hardware was used, but it has been found that lighter weight hardware can be used satisfactorily. Needless to say, women are most enthusiastic about the reinforced plastic doors because of their light weight and beauty.

CREDITS: Glass mat from Ferro Corp.; Vibrin polyester resin from Naugatuck Chemicals.

Photos courtesy U. S. Rubber Co.

Molding glass-reinforced polyester into specially designed sandwich-type sheets gives them high torsional strength and rigidity when used as panels in overhead garage door

When closed, door lets daylight pass to illuminate garage interior, at the same time provides complete privacy



Close-up of door panel section; expanded sheet (single sheet at edges, double sheet in center) with expander in center space gives rigidity

Functional, low-cost barn, 83½ ft. in diameter, is made up of 76 triangular-shaped reinforced plastics panels mounted in a framework of wood

Tomorrow's Barn

A VIVID example of the adaptation of plastics materials to the creation of more attractive, more functional structures, is seen in the use made of polyester-fibrous glass laminate in the design of an unusual barn recently erected on a farm near Montreal, Quebec, Canada.

Known as a geodesic structure, the barn is domical in shape, measures 83½ ft. in diameter and 32½ ft. in height, and consists of 76 triangular-shaped translucent reinforced plastics panels fastened at only 72 points to a pre-cut phenolic-laminated wood framework. It was designed by Jeffrey Lindsay, Montreal designer and director of the Canadian Div. of the Fuller Research Foundation, for the 90-acre dairy farm of Dr. John Hackney and is large enough to comfortably accommodate 30 cows, a silo, poultry house, and a refrigerator and deep freeze unit for storing fresh cream and poultry.

Structural Advantages

According to the designers of the geodesic barn, its structural advantages are many, particularly in the ease with which it can be erected. Provided a boom is used to place the reinforced plastics panels in position, the entire building can be put up in a single day. The necessity for using a boom takes the shelter out of the "do-it-yourself" category, but the building costs still remain considerably below those of a comparable barn constructed by conventional methods.

Since the framework, which is held together at each joint by stainless steel aircraft cables developing tension of 16,000 lb., is completely triangulated and domical in shape—therefore rigid in itself—no foundation is necessary. Concrete leveling pads are required, however, to facilitate erection and provide a light footing. The perimeter of the wooden framework is buried in the ground to securely anchor the unit.

The reinforced plastics panels provide lateral support to the laminated wood frame, thereby effectively reducing the required frame section.

Laminate Panels

The 76 triangular panels are prefabricated of polyester resin-impregnated sheets of fibrous glass mat,

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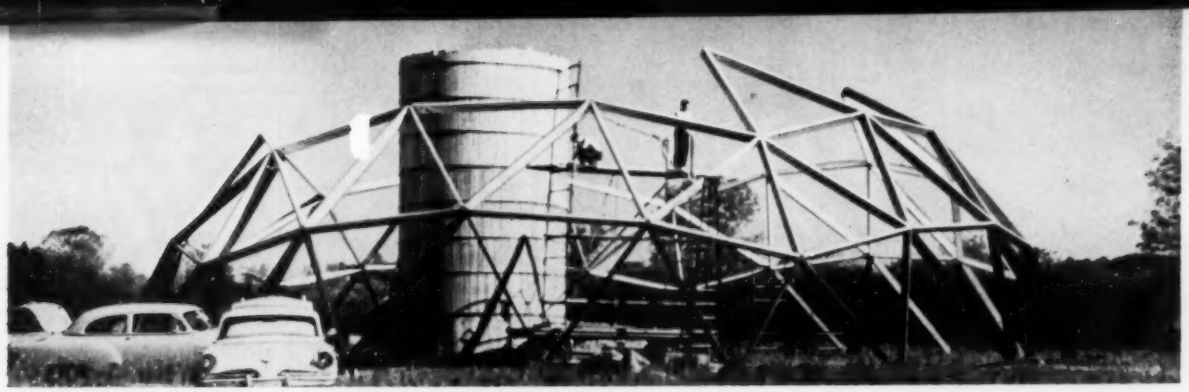
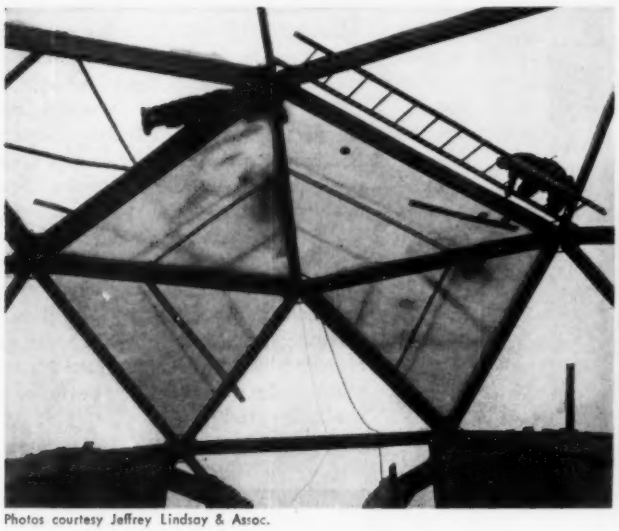


Using only concrete leveling pads, the wood skeleton framework for the barn can be erected in a matter of hours (above). The prefabricated panels are then hoisted into place and fastened securely to the wood frame members by a groove-and-channel arrangement (below, left). The completed structure is large enough to serve as a comfortable year-round shelter for 30 cows (bottom, right)



Photos courtesy Jeffrey Lindsay & Assoc.

Today

Geodesic structure built up of prefabricated triangles of reinforced plastics is easy to erect, needs no foundation, can be trucked to site in one load

In warm weather, the bottom of the barn can be left open; in bad weather, a fabric curtain is rolled down to completely close in the open areas

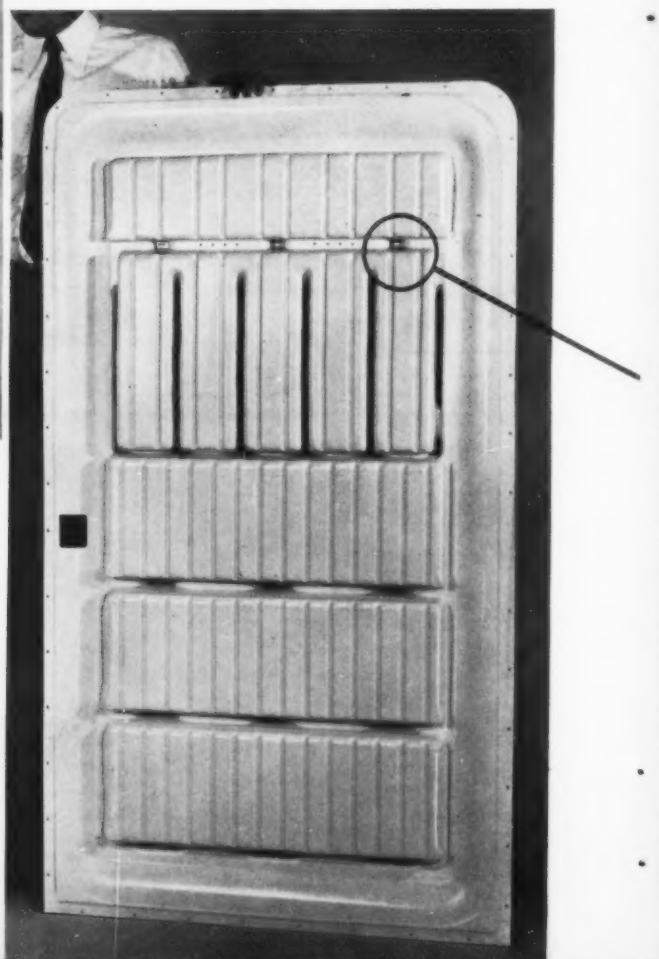
Freezers Go To

Some 20 parts, the largest over 58 in. high and weighing more than 9 lb., are being used by Deepfreeze in 1955 models

PROMISING new fields for vacuum formed thermoplastic sheet materials are opened by the success of a group of components adopted by Deepfreeze Appliance Div., Motor Products Corp., for several of its 1955 upright freezers and freezer-refrigerators. Among the parts, all of which are formed from sheets of extruded high-impact styrene alloy material, are several large inner door panels having unusual "built-in" features; in addition, breaker strips, crisper bins, evaporator drain trays, meat dishes, and other parts are similarly produced.

Courtesy Deepfreeze Appliance Div., Motor Products Corp.

Styrene inner door liner for freezer unit is vacuum formed in one piece complete with integral shelf supports for storing frozen foods and special dispensing racks for canned juices



Rear view of the inner door liner for the freezer shown above illustrates the manner in which complicated undercuts are produced in the front half of the liner by forming the styrene sheet around orphan inserts (circle) pre-cut to the desired shape. These inserts remain permanently in position in the liner when the formed part is removed from the mold

Vacuum Forming

Although vacuum formed sheet plastic components are not new to the refrigeration field, the Deepfreeze program is notable for at least three reasons. In the first place, some 20 parts are involved, comprising what is probably the most complete group of formed plastics components yet adopted by any refrigerator manufacturer. Second, several of these parts were made possible by new production techniques which undoubtedly will have an important impact on future design thinking. And, finally, this pioneering activity by Deepfreeze illustrates successful results possible when there is close cooperation between an appliance manufacturer and his fabricators.

Pronounced Undercuts

From the design and production standpoint, the new Deepfreeze inner door panels are the most interesting and significant of the vacuum formed components. They are notable not only for their size, but also for such integral features as shelf supports and dispensing type package racks with pronounced undercuts in the vacuum formed parts. These features reduce the number of final assembly operations and provide an easier-to-clean inner door panel. They are made possible by the use of an unusual forming technique involving "orphan" inserts placed in the mold prior to the forming operation; these inserts produce the desired undercuts, then separate from the mold when the part is removed, remaining in the piece and adding to the strength of the finished part. This technique removes certain design limitations customarily associated with vacuum forming.

Design features made possible by orphan inserts are best illustrated by three inner door panels used on Deepfreeze Dispensadors, which provide increased food storage space and convenience in the finished products. On the two large upright freezer models, these doors provide for storage and automatic dispensing of up to 24 cans of frozen fruit juices while four roomy package shelves efficiently store up to four dozen frozen food packages. The upper door of the third model covers the regular refrigeration compartment and incorporates a bottle compartment, removable egg racks, a butter and cheese compartment, and a high-humidity crisper. All the Dispensador panels are ribbed for air circulation; the ribs also function to contribute added rigidity and strength to the panels.

Porcelain-Like Surface

The plastic material in the inner door panels and other vacuum formed parts in the new Deepfreeze models is produced by Campco Div., Chicago Molded Products Corp. It is an extruded sheet having a brilliant, porcelain-like finish, high impact strength, excellent dimensional stability, and low moisture absorption. The gloss finish of the basic sheet is reported to be further enhanced by the vacuum forming process.

In developing the original Deepfreeze concept of vacuum forming the highly detailed inner door liners and other thermoplastic sheet parts, the company's engineering department, headed by H. W. Whitmore and with Florence B. Anderson as chief design engineer, worked closely with a number of fabricators. The design of each part was based on the adaptability of vacuum forming techniques to production of the required pieces. As projected by Deepfreeze, the program required a study of vacuum forming as related to its design requirements and finding fabricators who were capable of working out satisfactory answers to production problems.

All of the design details, including scalloping the shelves, ribbing the rear walls of the door panels, and the incorporation of orphan inserts were developed by Deepfreeze before release of prints to vendors. Later, various experimental parts based on Deepfreeze requirements were made for sampling and evaluation. Among those fabricators now supplying Deepfreeze with production parts are Regal Plastic Co., Kansas City, Mo.; Fabri-Form Co., Byesville, Ohio; Woodall Industries, Inc., Cleveland, Ohio; and Cortland Industries, Chicago, Ill.

Back of all this planning and de-

Courtesy Regal Plastic Co.

Despite the extreme draws involved in forming the liner, the insert (close-up, above) produces a sharp undercut at the front end of the shelf support (right, circle)

Courtesy Deepfreeze Appliance Div., Motor Products Corp.

Removable tip-out crisper bin, formed of styrene copolymer sheet for freezer-refrigerator model, pivots outward on projections formed into the liner

velopment work was an experimental polystyrene sheet door liner draw formed for Deepfreeze by Regal, purely for evaluation purposes. This part was formed over a shallow molded paper-base phenolic liner with no integral ledges or troughs. Price was too high at the time but, later, the Deepfreeze engineering and design department re-opened the problem by considering the possibility of vacuum forming a liner which would incorporate integral shelf supports and undercut projections to form trays and vertical troughs in which frozen food packages could be stored for convenient dispensing.

As a result of conferences between Deepfreeze and Regal representatives, Deepfreeze suggested the possibility of placing removable metal inserts in the aluminum forming die, the inserts to remain in place in the formed part. After experimental samples had proved the principle, a sample door liner was made up which measured 58¾ in. high by 34 in. wide, had a maximum depth of 4⅜ in. and weighed 9¾ pounds. It included three undercut flanges for shelf supports and six vertical flared flanges to hold and dispense frozen food cans and packages.

An important consideration was the fact that Deepfreeze wished to avoid heavy tooling commitments predicated on high production runs. By using a number of components made of formed thermoplastic sheet material, the company was able to contemplate moderate-sized runs with a relatively low tooling investment. This approach also afforded considerable flexibility of design and a possibility of making running changes as items were developed.

Upon receipt of orders for four door liners and three sets of breaker strips, Regal Plastic Co. had about four weeks to complete tooling and deliver production samples for final decision as to thickness of material to be used. From these initial parts, Deepfreeze officials designated that 0.125-in. stock should be used for the door liners and 0.100 in. for the breaker strips. The greater thickness

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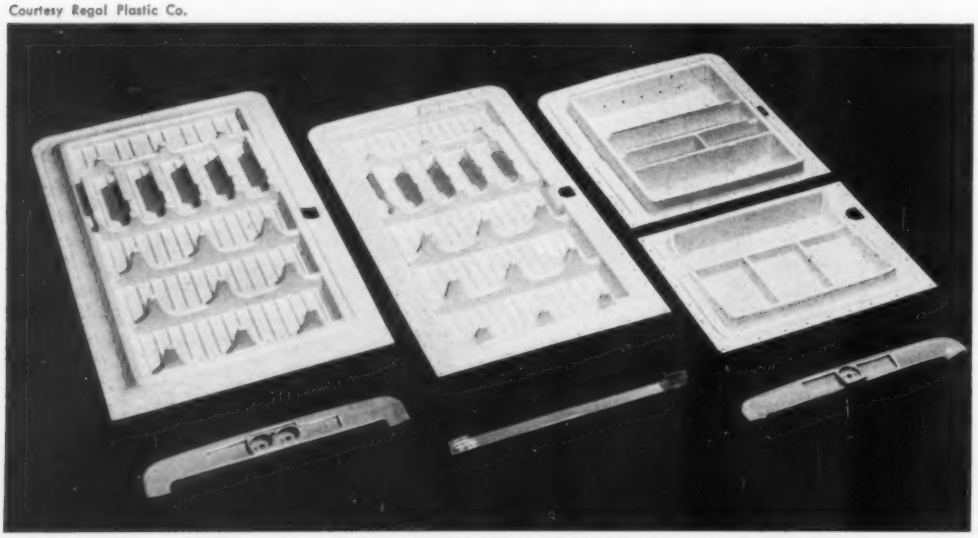
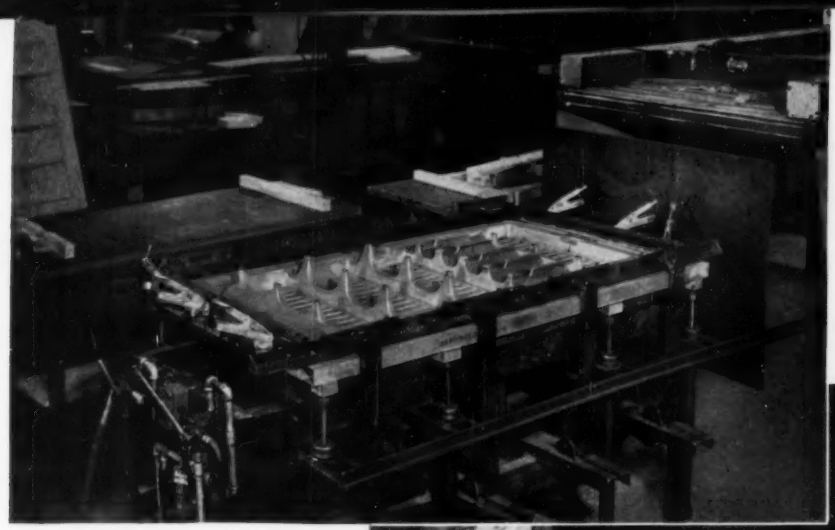
Courtesy Regal Plastic Co.

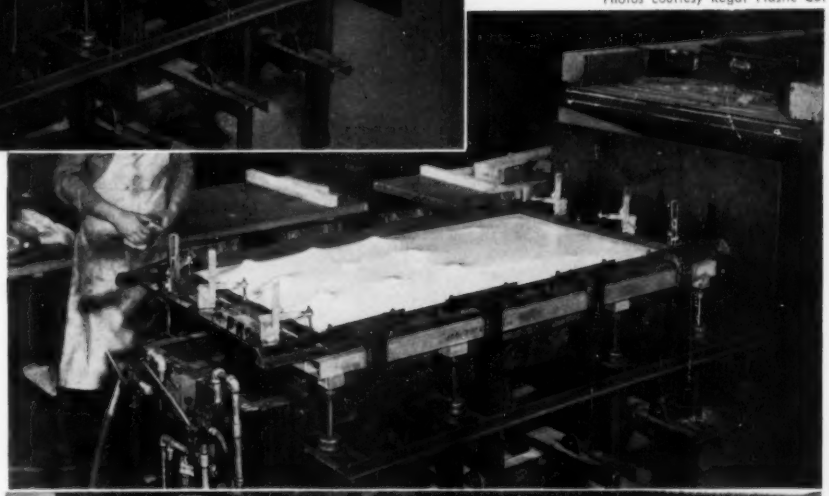


Vacuum formed freezer parts, ranging from deep door liners (top row) to shallow breaker strips (bottom row), are notable for sharpness of detail

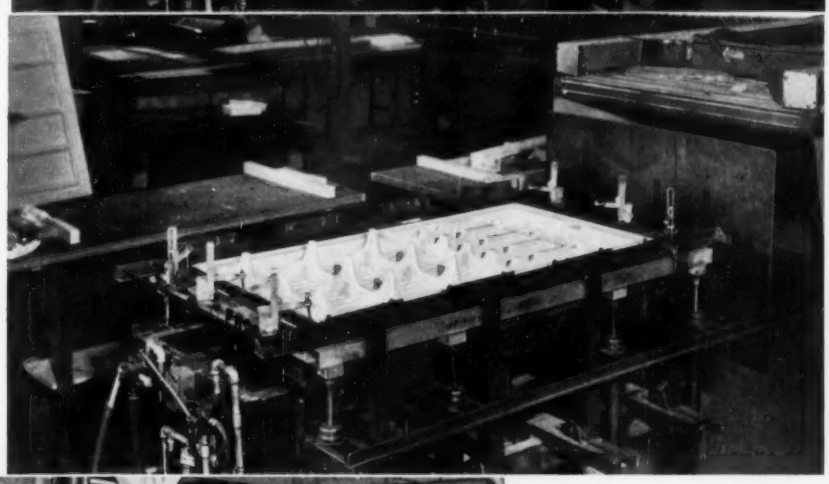


Aluminum mold for freezer inner door panel is set up on the bed of the forming machine with the pre-cut orphan inserts and clips already pinned in place at the top of the upright projections in the mold

Photos courtesy Regal Plastic Co.



Prior to pulling the vacuum, the sheet which has been framed in place above the mold is heated by infra-red lamps for 50 sec. and allowed to drape over the mold



Vacuum is then pulled, sucking the heated sheet into the valleys of the mold and around the inserts which form the undercut sections. The formed piece is cooled briefly before being removed from the mold

Using a die mounted in a 60-ton, double acting toggle press, the formed piece is simultaneously punched and trimmed. Complete time cycle for all operations from setting up the mold to trimming is 8½ minutes

3D

Close-up (above) of decorative vinyl sheet for ladies' handbag (right, top), shows the minute detail captured in the ¼ in. deep rose pattern by means of advanced vacuum forming techniques

In addition to handbag applications, formed three-dimensional vinyl sheeting, appropriately colored, is especially adaptable to fabrication of low-cost, high-quality wallets

Even the most intricate petit point needlework (top) and delicate pearl bead patterns (foreground) are faithfully reproduced in the formed 0.018 in. thick elastomeric vinyl sheeting
Courtesy Original Plastics, Inc.

WITH a well-established background in place-mat applications, vacuum formed vinyl sheet is now being successfully used as a three-dimensional material for the manufacture of an impressive variety of wallets, handbags, novelties, cases, and lampshades; it is also a possibility for upholstery applications.

Within a relatively short time the vacuum forming of flexible materials has developed into the "fine art" of the sheet fabrication field. Careful attention to mold making and perfection of production processes have paid off in the development of techniques that make it possible to reproduce intricate details with extreme clarity and depth.

VINYL SHEET

Vacuum formed material, given multi-color effects by ingeniously simple methods, is being used in an impressive variety of end products

One of the companies specializing in this type of work is Original Plastics, Inc., West New York, N. J. Included in the company's line of vacuum formed vinyl sheet is one that duplicates in the minutest detail the intricacies of petit point needlework. Another is based on an attractive flower pattern in which a series of detailed roses are perfectly formed to a depth of approximately ¼ inch. Still other complicated patterns have been successfully formed to a depth as great as ½ inch.

Metal Molds

Original Plastics works only with elastomeric vinyl sheet materials in the 18- to 20-gage range, and in sizes up to 26 by 52 inches. The entire vacuum formed sheets are supplied to end-product manufacturers who die cut individual sections out of the sheet, trim them, and then, either by heat sealing, gluing, or sewing, apply the formed vinyl sections to the finished product.

Attesting to the versatility of the vacuum forming process are the more than 40 standard designs available from Original, ranging from a simple, shallow rope-like design to complicated multi-colored flower patterns. In each case, emphasis is on reproduction of minute detail. For this reason, and because the flexible vinyl sheeting will pick up even the slightest imperfections from the mold surface, most of the molds used by Original are either sprayed metal or electroformed.

Methods for making sprayed metal molds for forming flexible vinyl sheeting differ somewhat among the various companies in the field. A basic method, which most seem to recommend is described briefly as follows: If a fabric is to be reproduced, a sample of it is mounted on a board. Small-diameter pins that

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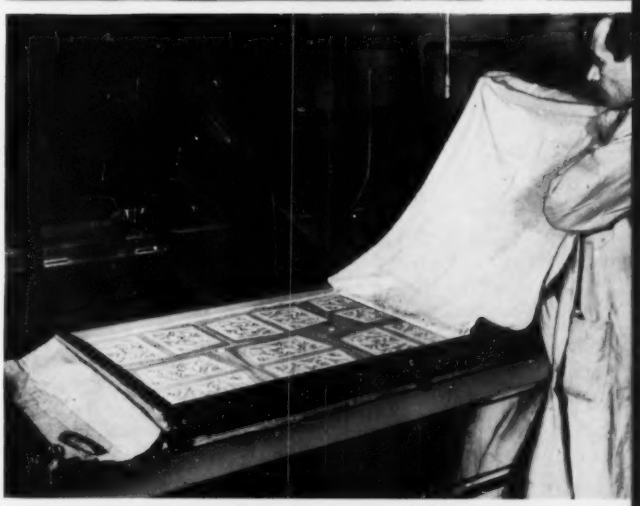
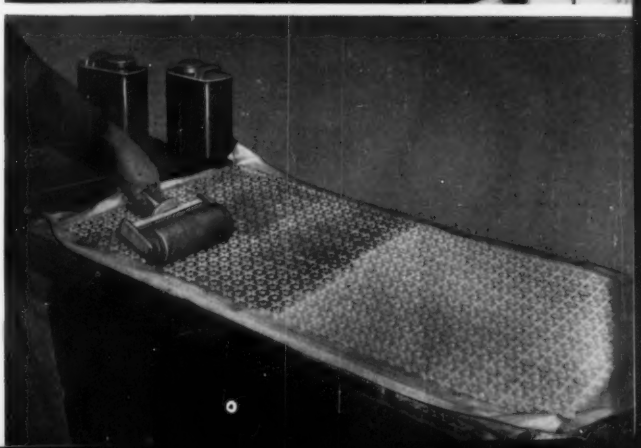
Flexible vinyl sheet which is to be vacuum formed is laid on top of the female molds that have been set up on the bed of the machine. Sheet is then clamped in place



After the heater has been rolled back and the heated sheet drawn tightly against all the mold surfaces, vacuum is released and the formed sheet is pulled off



To create multi-color effect, one color is first applied to flat areas of transparent formed sheet with a roller. Second color is then sprayed on to fill in raised areas

Photos courtesy Reichhold Chemicals, Inc.

Reinforced plastics plane with a 35-ft. wing spread and a 24 ft. long fuselage is lighter in weight, easier to maintain, smoother riding than conventional aircraft

New Light Plane —90% Reinforced Plastics

IN THE nearest approach thus far to an all-plastics aircraft design, a small prototype has been built by Taylorcraft, Inc., Conway, Pa., with almost all its parts fabricated of polyester resin-fibrous glass laminate. Called the Ranchwagon, approximately 90% of the airplane, exclusive of the engine, is made up of reinforced plastics, including the two-piece 24 ft. long fuselage and the 35-ft. wings, as well as the ribs, spacers, struts, wheel fenders, doors, seats, and the engine cowling.

From the standpoint of economy alone, the reinforced plastics plane has already attracted considerable attention from the aircraft industry. The current price for the 225-hp. Ranchwagon is $9000—at least $1500 less than comparable aluminum or doped fabric covered small planes. Company engineers predict, however, that as production capacity is increased and as the laminate construction is applied to other parts of the airplane, including structural members, costs will be lowered sufficiently to bring the reinforced plastics plane into a price range where it can compete with the automobile.

Production Line

Although only the original prototype Ranchwagon has been made thus far, five new units are already under construction and plans are being made to set up a production line by the end of 1955 for fabricating the planes at the rate of one a day.

Using low-cost steel, aluminum,

Strips of closely woven fibrous glass cloth are laid up in the metal mold for one half of the fuselage section. Liquid polyester resin is then brushed over the cloth by hand

After the entire fuselage half, including molded-in supporting ribs, has been laid up and cured, it is removed from the mold. A second mold (visible at the left) is used to simultaneously lay up the other half of the fuselage section

and reinforced plastics molds, the two halves of the fuselage section and the 60 additional reinforced plastics parts that go into the plane are laid up by hand. For maximum strength, an extra-tightly woven fibrous glass cloth is used. The liquid polyester resin, with antimony oxide added to make it self-extinguishing, is then brushed on the laid-up cloth and the part is cured.

Additional production economies are achieved by designing the various plastics parts to eliminate the need for much of the bolting, riveting, and other time-consuming and expensive handwork that are primarily responsible for the high price of aluminum and fabric-covered airplanes. The fuselage, for example, is formed in two halves, each of which extends the full 24-ft. length of the plane from nose to tail. Each half is then fastened to a frame network of tubular steel and the two parts are fused together in a simple assembly step.

Low Maintenance Costs

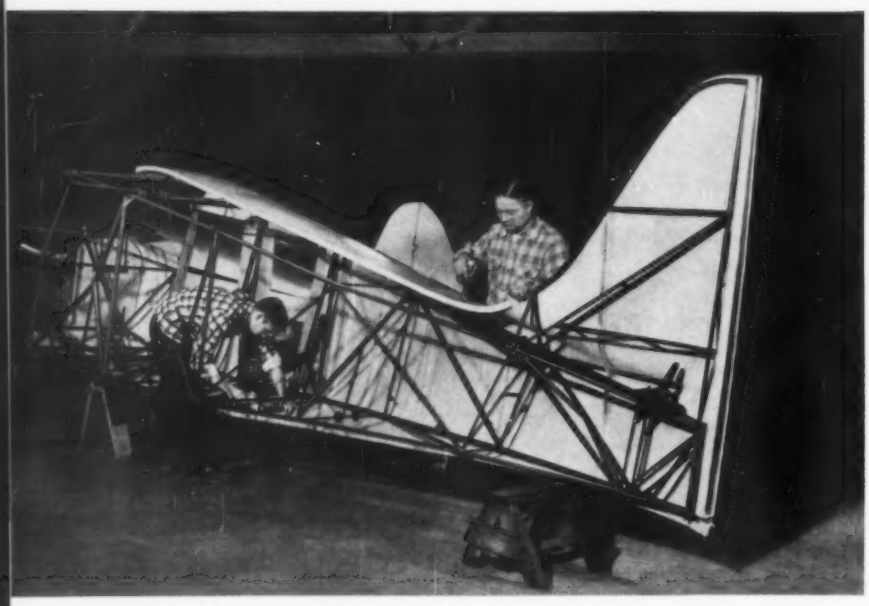
Of special significance to the potential purchaser of the Ranchwagon is the unit's low maintenance cost. Unlike planes with aluminum or fabric covered bodies, the reinforced plastics plane is strong enough to withstand all of the elements; it will not dent, tear, or warp, and, therefore, does not need to be housed at high rental fees in a hangar.

In the event that the body of the reinforced plastics plane is damaged in any way, however, all that is needed for a quick repair job is a can of liquid polyester resin, a piece of fibrous glass cloth, and a putty knife. The damaged area is simply covered with the cloth, the resin is smeared on, and the repaired section cures at room temperature. The repair will have the same glass-like smooth finish as the rest of the plane.

Maintenance requirements for other types of aircraft provide a marked contrast. Resectioning a ruptured aluminum skin, for example,

Photos courtesy Reichhold Chemicals, Inc.

By molding the fuselage section in two complete halves, production time has been cut to 1/3 that required for conventional aluminum or doped fabric covered aircraft



Assembly costs for the Ranchwagon are also lower than those for conventional aircraft. The two fuselage halves are simply riveted to a tubular steel frame and fused together

is an expensive and time-consuming operation and patching a doped fabric covering is not only a difficult job but one that often directly affects the aerodynamic characteristics of the skin. To maintain a doped fabric covering, it is also necessary to replace the skin every three to four years in normal use.

Tensile Strength

The outstanding strength-to-weight ratio of the polyester resin-fibrous glass laminate offers a maximum safety factor to the pilot of the plane. The tensile strength of the reinforced plastics skin used in the construction of the Ranchwagon is in excess of 9000 p.s.i.—equal to the strength of aluminum alloys conventionally used. As part of a series of durability tests conducted on the prototype, the plastics wheel fenders were struck viciously with a 3-lb. hammer without being damaged; an aluminum fender, in contrast, was dented merely by being struck with the butt of the hand. In another test, the reinforced plastics door of the plane was removed, slammed to the ground, picked up, hurled 10 ft., and then jumped upon. When put back on the plane, the part still fitted perfectly and showed no evidence of abuse.

From the standpoint of performance in the air, the reinforced plastics plane has still other major advantages. Because of its light weight, the plastics plane is easier to handle and gives a smoother ride. In addition, the aerodynamic qualities of the smooth surface of the laminate increase the speed of the Ranchwagon 12 miles an hour over that of a comparable fabric-covered model, increase the rate of climb of the plane, shorten its take-offs and landings, and increase its rate of glide.

Corrosion Resistance

The corrosion resistance of reinforced plastics is also expected to play a major role in developing a market for the material in the construction of small aircraft. About 5000 of the 90,000 small planes registered in the United States today are being used for agricultural seeding, dusting, etc., and such use is rapidly expanding.

Because the chemicals, insecticides, concentrated fertilizers, etc., used in this work are generally corrosive in nature, the life span of an aluminum or doped fabric covered airplane body is comparatively short.

The reinforced plastics body, by contrast, effectively resists the corrosive action of these chemicals, thus offering unlimited service life for agricultural purposes.

According to the manufacturers of the reinforced plastics plane, its many advantages—from the standpoint of cost, maintenance, and performance—will do much to expand the popular use of small aircraft in this country. As one leader in the aircraft industry put it, "if the industry's dream of 'an airplane in every garage' is ever going to be brought into reality, it seems likely that it will be the reinforced plastics plane that will lead the way."

CREDITS: Polylite polyester resin for the Taylorcraft Ranchwagon supplied by Reichhold Chemicals, Inc., White Plains, N. Y. Glass cloth woven by Hess Goldsmith & Co., New York, N. Y., using fibrous glass supplied by Owens-Corning Fiberglas Corp.

Plastics Music Teacher

MAN'S most modern and versatile materials—plastics—are helping to make possible an entirely new approach to one of his oldest arts—music. This new approach has been brought about by Carl Rupp, member of ASCAP and well known Chicago pianist, composer, and orchestral director, who has devised a basically simple unit to facilitate piano instruction. Placed directly above the piano keyboard, this device, known as Play-It, displays a printed roll which shows the beginner exactly which notes to strike for a given selection and which fingers should be used. Shifting the roll to each successive set of notes is accomplished by means of a foot pedal.

First models of Play-It were made of wood. At a recent annual meeting of the National Association of Music Merchants, Mr. Rupp unveiled a new version of the Play-It piano roll device, constructed almost entirely of molded plastic parts.

Attractively styled and injection molded of medium-impact styrene material, Play-It consists essentially

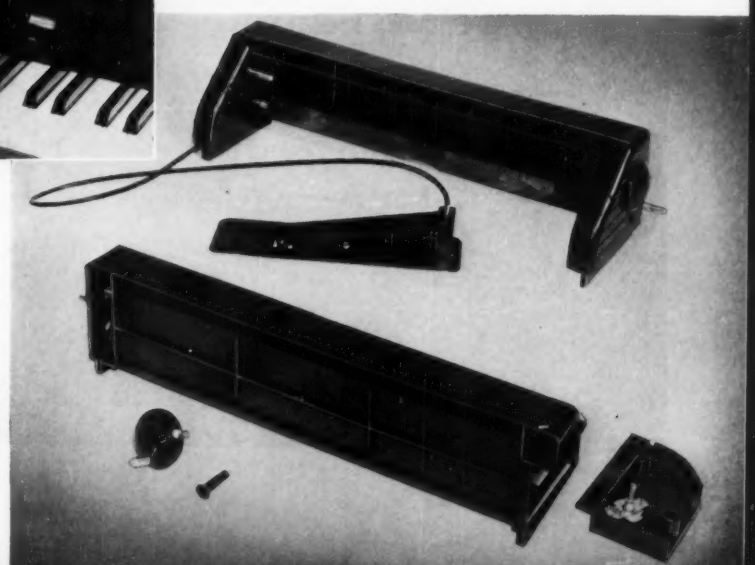
(*To page* 221)

Molded styrene housing holds printed roll which is advanced to show piano student which notes to strike

All photos courtesy Play-It, Inc.

Placed directly above the keyboard, pedal-operated piano playing teaching aid has housing molded of styrene

Close-up of piano attachment. Arrows on roll indicate which keys to strike and which fingers to use



Front (top) and rear view of housing. Reinforcing ribs are used to add strength and dimensional stability. Left end plate (lower right) accommodates metal drive sprocket. Rewind knob and cored pin are at lower left

Calendering or Spread-Coating?*

Comparative data on methods of producing vinyl-coated fabrics, with an analysis of the advantages and disadvantages of each

by DE FOREST LOTT†

VINYL-COATED fabrics have been making impressive sales gains over the past three or four years. Nearly everyone in the industry expects that growth to continue for some years to come. Improvements in resins, compounds, equipment, and handling techniques have by no means reached the end; users are becoming more and more pleased with performance.

The vinyl coating may be applied to the fabric backing by either calendering or spread-coating. The latter is also called dispersion-coating since plastisols or organosols are generally used; standard vinyl compound is used in calendering.

The purpose of this article is to point out some of the differences between these two coating methods insofar as equipment, costs, and end results are concerned. The idea is to give the reader a picture from which he can decide whether any given operation can be most practically conducted by calendering or by spread-coating.

Differences in raw materials such as resins and plasticizers will not be considered here. And, of course, unsupported film or sheeting has no place in these remarks.

Vinyl-coated fabrics are used primarily for automotive and furniture upholstery and trim, luggage coverings, leather-like novelties, seat cover trim, military purposes, and other applications.

Vinyl-coated products are all generally characterized as having eye appeal and decorative and style qualities obtained by embossing and secondary color applications after the coating operation. These secondary applications will not be considered in this discussion.

The fabric backing to which the coating is applied may be woven, knitted, or non-woven cloth or webs over which is spread a compounded film of polyvinyl chloride or vinyl copolymers. The web backing or fabric may weigh from 2 to 10 oz. per sq. yd. and the film or compound application may vary from 3 to 15 oz. or more per sq. yard.

Comparison of Output

To compare and evaluate the two coating systems, a sound rate of machine output must be established.

A fair measure of output of coated fabric from one 24- by 66-in. four-roll calender, applying compound from 6 to 15 mils in thickness, at currently acceptable speeds, can be set at about 1200 to 1500 lb. per hour. For a modern spread-coating machine the average would be about 250 to 300 lb. per hour. Thus, five spread-coating machines would be necessary to obtain the average net hourly output of one calender.

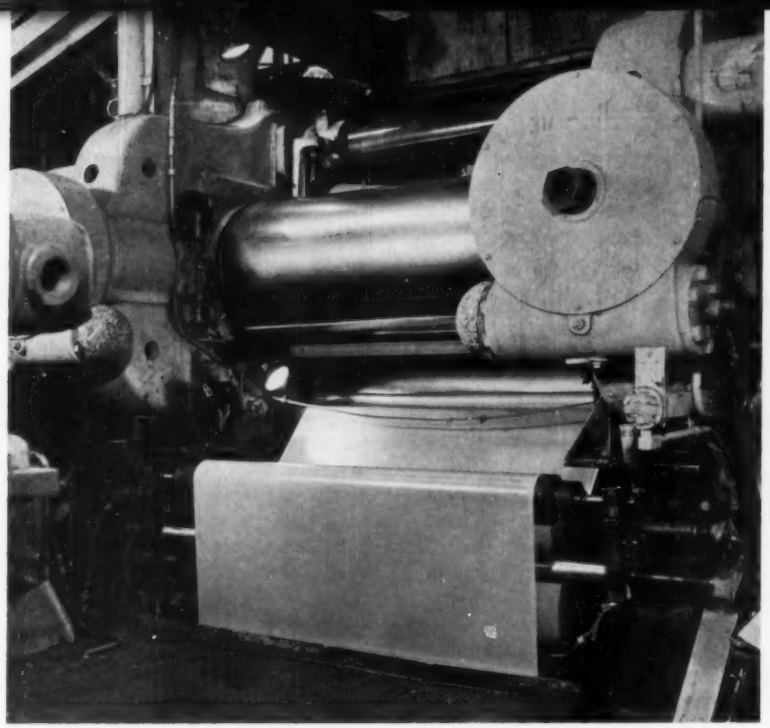
Equipment for Calendering

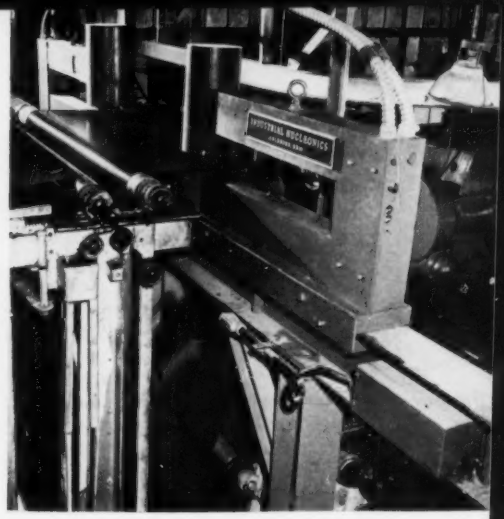
Complementary processing equipment needed with a calender includes one or two ribbon-type blenders, one or two Banburys, and one 60- to 84-in. mill. Additional auxiliary equipment, sometimes essential and sometimes installed by preference, includes weighing and measuring devices, embossing attachments, strip feeders, preheaters, tensioning units, and other ingenious gimmicks which serve an end purpose peculiar to the particular needs of the moment or to the type of business of the user. Last, but not least, are control devices which will be discussed in more detail later.

Basic ingredients for a vinyl coating formulation are carefully weighed. Before reaching calender for application to fabric backings, they will be mixed in a Banbury

* Adapted by permission from a paper presented before the 5th Plastics Film, Sheeting, and Coated Fabrics Div. Conference, S.P.I.

† See portrait and panel, p. 106.





Beta gages on calender permit efficient quality control of vinyl-coated fabric

Heated, polished rollers on calenders are adjustable, control amount of vinyl coating on fabric

The labor force to operate such a calendering set-up would be of the order of 10 men whose jobs would include such servicing as bringing cloth to the machine, taking the product away, sewing seams, and disposing of scrap.

Sequence of Operations

First operation in calendering is the blending of the resin, plasticizers, fillers, and stabilizers. Then batches are weighed out for the Banbury and preweighed pigment batches (paste or dry) are added at the time the Banbury is charged.

A 3A Banbury used with the recently developed high bulk density resins will take a charge of approximately 200 lb.; the mixing cycle will be from 1½ to 2 min. in a high-speed Banbury and 3 to 5 min. in a slow-speed unit. Thus, Banbury capacity can vary from 2400 to 8000 lb./hr. in continuous operation and a slow-speed Banbury can keep pace with the basic calender output figure given above; a high-speed unit can support a calender speed up to double that figure.

Color Matching—The weakest spot in the procedure just outlined is the requirement for frequently repeated weighing of color pigments in small increments incident to the small size Banbury batch. As long as colors are weighed by hand and judged by the human eye, just so long will there be color troubles in maintaining continuity from batch to batch and run to run.

Along with the basic equipment for calendering it is almost imperative that a product control laboratory be included in the same area. Among the functions of such a laboratory are checking of blender batches for physical qualities before they are dumped, checking of color before a run is allowed to proceed on the calender, and checking of adhesion of compound to cloth as the run progresses. These quality control procedures must be coincidental with the run in order to be of any real value in preventing production of excessive amounts of off-standard materials.

Weight Control Essential

Also necessary for an efficient calendering set-up is a means of controlling over-all weight of the material being produced. The coated fabrics industry, for the most part, sells its products on a basis of finished weight — so many ounces per yard. The fabric base varies in weight within the same piece of material by fractions up to as much as an ounce, and even more, per yard.

If the fabric is light to standard, additional coating must be supplied to bring the finished material up to specified weight in order to keep the customer happy. If the fabric is slightly over-weight, there is no necessity for giving the customer more than he pays for. Vinyl compounds are expensive.

Weight Gages—Until a few years ago, there were a variety of contact, weigh scale, and magnetic gages in use for weight control—all of which operated with rather indifferent success.

With the coming of the atomic age and radioactive isotopes, the beta gage, a non-contact instrument, was developed. When set in the calender train with the coated material running in a gap between the source of radioactive energy and a receiver, the gage makes it possible to control accurately and precisely the amount of compound money being spent to produce goods to a given specification. This factor is of vital importance since a deviation of only 0.001 in. of thickness of film applied, beyond that necessary to meet specification requirements, costs roughly 3¢/yd. on 54-in. material, for which the manufacturer receives no payment. The beta gage gives the operator a constant picture of any deviation from standard. When installed on both sides of the web, it immediately reflects any off-balance or uneven coating from edge to edge, without production delay.

Floor Space Needed—The equipment and control laboratory for a calendering line can be accommo-

THE AUTHOR

DeForest Lott, Chief Development Engineer, Textileather Div., General Tire and Rubber Co., Toledo, Ohio, joined Textileather in 1922 and has served his entire business career with that organization. He was appointed Vice President in charge of research and development in 1946 and became Chief Development Engineer following the merger with General Tire a year ago. For 10 years he was chairman of the technical committee of the trade association now known as the Plastics Coating and Film Association. He served as a member of the two-man coated fabrics team for the Technical Industrial Intelligence Committee of the U.S. Government which surveyed German industry and research after World War II.

dated in approximately 6000 sq. feet. This is operating space only and does not provide for storage of raw materials or finished goods.

The building should preferably be three stories high. On the top floor will be the blenders which feed by gravity to the second floor weigh scales. The second floor takes care of color batch weighing, Banbury batch weighing, and charging of the Banburys which discharge to the first floor either directly onto the mill or adjacent to it. The first floor layout includes Banbury, mills, and calender, including feed and take-off arrangements and control laboratory. Initial cost of such a layout should be about $300,000.

Pros and Cons of Calendering

The crux of the problem as far as the calendering system is concerned is initial cost. The output from the outlined set-up, based on application of an average of 1 lb. of compound per running yard, will be about 10,000 yd./8-hr. shift. A calender set-up can be summarized, in general terms, as a close-coupled compact unit high in hourly output and capable of precise control in material usage and product. On the other hand, it could be considered as fairly vulnerable to damage and consequent total interruption of production, and it is not economically adaptable to short runs in the 50- to 500-yd. range.

Its ability to produce a wide range of materials in any weight above the minimum is well established. The process is simple and repetitive, once set for a given run.

Dispersion System More Variable

Consideration of dispersion or spread-coating is somewhat more complicated since there are several varieties of equipment and two types of resins — organosols and plastisols — which can be utilized.

Organosols are usually prepared by pebble mill mixing, which requires not less than 4 hr. in the mill. They contain from 60 to 75% solids, the balance being low-cost hydrocarbon diluents. Plastisols or pastes are usually prepared as simple stir-in mixes at 100% solids.

As stated previously, five coating machines and their fusing ovens are required to equal the output of one calender. For dispersion type coating, the following additional equipment would be needed for a volume of 10,000 lb. per working shift:

The simplest set-up for minimum requirements with adequate flexibility would call for at least four change can mixers of a capacity which would permit mixing of 250- to 300-lb. batches. The time required is about 45 min. per batch. In order to service these mixers, two or three paint mills would be necessary for grinding pigment and plasticizer, figuring an output of 300 lb./hr. for two passes. An additional mixer would be needed for premixing pigment pastes before grinding.

Auxiliary equipment would include weigh scales, pigment storage bins, can cleaning equipment, color matching lights, and touch-up facilities.

A small laboratory is desirable for checking color grinds and individual batches for color and viscosity and taking care of the necessary viscosity adjustments.

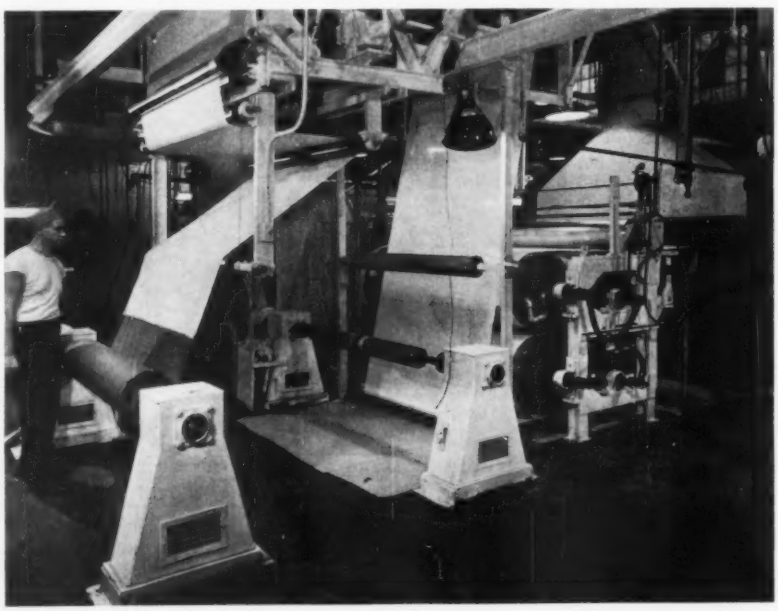
In some cases where the higher viscosity mixes are used, it has been found necessary to de-aerate the batches before use in order to assure satisfactory film density.

Coating machines and their ovens vary almost as much as people. There have been some very ingenius and apparently adequately successful conversions of old pyroxylin drying ovens to use as organosol and plastisol fusing ovens. In the case of organosols, a two-zone system must be employed, the first zone to drive off the solvent and the second zone to fuse the residual film.

Basically, there are three systems generally available for the evaporating and fusing phases in coating:

1) Hot air convection heaters us-

After vinyl-coated fabric emerges from coating machine ovens, it is continuously inspected to make sure that material with surface defects does not reach market channels



ing either steam, gas, oil, or electricity or a combination of these heat sources.

2) Electrical radiant heat.

3) Combination of convection air heat in the evaporating zone and electrical radiant heat in the fusing zones.

Each of these systems is in fairly common use and can be adequately engineered to do a sound job.

Applying the Coating—There are probably 10 or 15 methods, differing only in detail, in use for actually applying the coating to the web. These methods can be broadly divided into two groups: knife-coating and roll-coating, and there are many variations of each.

The most commonly used method is knife coating which, in its simplest form, uses a floating knife set between two angle iron or roll supports with the fabric running over the angle irons and under the knife. The coating compound is positioned in front of the knife and rolls onto the cloth.

In this method the amount of spread is controlled by the contour of the knife edge, the angle at which it is set in reference to the face of the web, the amount of tension on the web, the rate of travel of the web, and compound viscosity.

There are many ways in which this system can get out of balance during the operation. Probably the most difficult phase to control in practical application is web tension.

The basic knife-coating method and all of its variants do not offer the means of precise control of compound application desirable for modern cost and quality standards.

Roll-Coating Offers Improvements

In recent years, much engineering effort has been spent and with some success on roll-coating equipment, designed to improve on or eliminate the short-comings of knife-coating.

In principle, the roll coater in any of its variety of forms could be classified as a little calender. The basic concept is that of accurately metering a film of the required thickness between two metal rolls before it is applied to the cloth.

Coaters of this type, in the initial stages, were somewhat crude but in the past few years machines have been developed with roll bearing tolerances of ½ mil, rolls with concentric tolerances of ¼ mil, and roll deflections of the same order. Such accuracy is bound to be expensive.

Roll Arrangements—Many different roll arrangements have been tried. The most generally accepted method today is some variation of the reverse roll coater which, oversimplified, deposits a predetermined thickness of wet film on a metal roll and wipes it off on the web which is travelling in the opposite direction to the face of the applicator roll.

In addition to being able to meter the amount of coating more accurately than in the knife method, the reverse roll coater also makes possible heavier applications of film in a single pass and, further, a reduction in the incidence of scratches in the film caused by foreign particles from the air or small aglommerates in the compound, to which the knife method is so vulnerable.

A European development recently announced claims to make it possible to apply from 70 to 125 mils of compound in a single pass and come up with an acceptable surface.

Still an Art—Roll-coat methods for spread-coating of vinyl on fabric are still comparatively new. Manufacturers who use this method are loath to talk. But it is no secret that roll coaters do not yet offer the precise control hoped for in original concepts. Yet the time is almost certain to come when a predetermined film thickness may be applied continuously and consistently by the roll-coat method. At present there are too many variables in spread-coating by either the knife or roll method to permit accurate control.

Since there are so many control points, the use of beta gages becomes of limited value. Because the reading must necessarily be taken at the far end of the fusing oven, there will be some time lag, which means that 10 to 20 yd. of off-standard goods will be produced before a correction can even be started. Of course, such gages would be helpful to an operator in giving him an over-all picture of what he is doing and through its use he could probably narrow the band of variations. A few such installations are in operation today and are presumably giving comparative satisfaction.

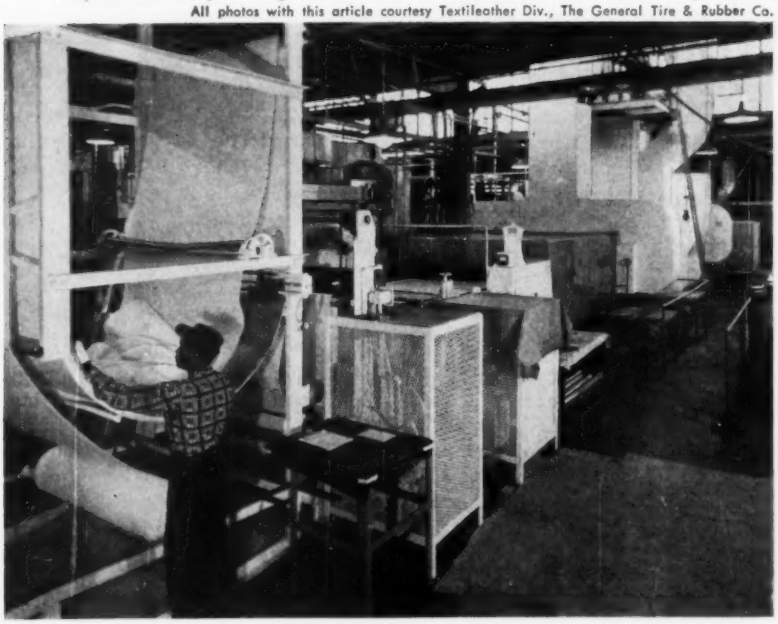
Cost and Space—The cost of a set-up for spread-coating equipment and space requirements would be about as follows:

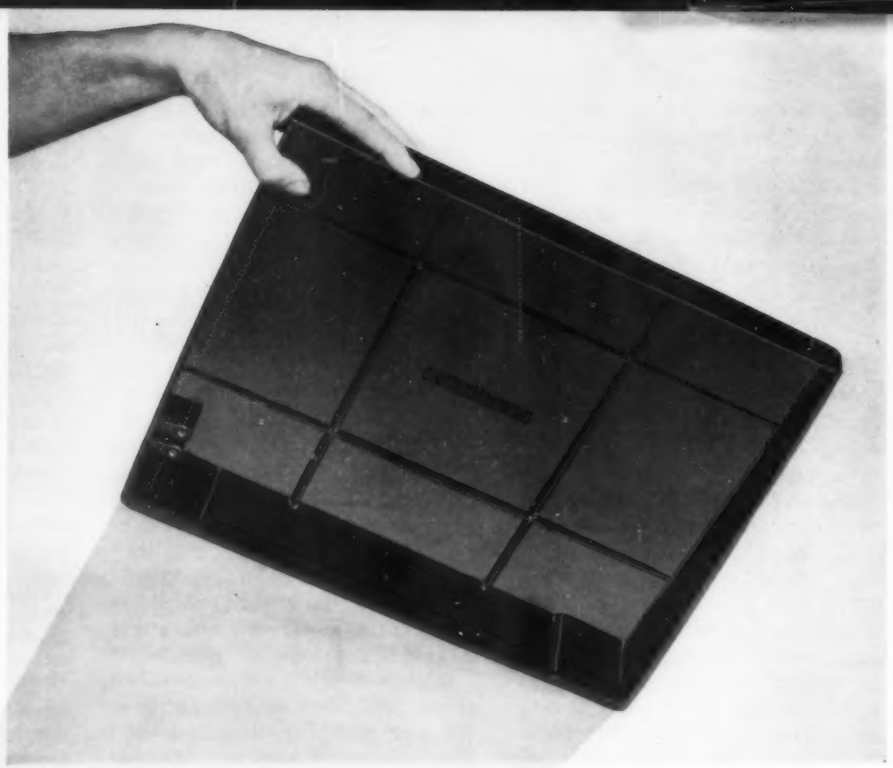
The mixing equipment would cost approximately $40,000 installed, and would occupy approximately 5000 sq. ft. of space. Five coating machines, having 50- to 60-ft. ovens, and allowing for space for continuous feed J-boxes, coating heads, and double take-offs to permit continuous operation would require an

(*To page 222*)

Coating machine for applying plastisol to fabric. J-box in foreground temporarily stores surplus material, permitting new rolls to be added without interruption of production

All photos with this article courtesy Textileather Div., The General Tire & Rubber Co.





Molded phenolic lid (right) of radio-phonograph combination cabinet (below) was produced in one of two "stacked" molds. Intersecting rib reinforcements, molded into the lid, contribute rigidity and strength. Cored bosses in the lower left-hand corner of the lid accommodate brass inserts for attaching metal support arm that holds lid open

'STACKED' MOLDS INCREASE

Courtesy Admiral Corp.

SIMULTANEOUS production in one molding cycle of two large phenolic lids for radio-phonograph combinations is achieved with economy in press operation by "twinning up" two identical sets of molds, one above the other, in a 400-ton compression press. Such placement of the molds permits molding two pieces with virtually the same molding cycle and pressure as required for molding the parts one at a time and with a press no larger than would be needed for a conventional one-cavity set-up.

The duplicate set of molds for the radio-phonograph lid job is run with the cavity halves mounted back to back and the punches or force plugs at the top and bottom. This arrangement places the top cavity face upward and the lower cavity in an inverted position. When the press closes, the two punches converge with cavity halves between them.

The lids for use on an Admiral table model three-speed record player and radio combination are molded of general-purpose phenolic material in ebony and mahogany mottle. Weighing just under 3 lb., each lid measures 16⅝ in. by 13 in. in size, tapering from a maximum depth of 3 in. at the back of 1¼ in. along the front edge. The tapered design not only increases the strength of the cover, but also contributes to more attractive styling.

The average wall section of the lid is approximately $\frac{3}{16}$ in., increasing to nearly ⅜ in. at the two back corners, where the sidewall is cored for four openings for attachment of the metal hinges. The hinge openings are produced by hydraulically operated side cores in the mold.

Design-wise, the cover is moderately crowned rather than flat; front and rear edges are straight while the sides curve slightly outward. The exterior surface of the cover is perfectly smooth, but the underside of the part is reinforced by four intersecting ribs. Two molded-in cored bosses provide attachment for the folding metal support that holds the cover in open position.

Unlike many plastics components,

these record player lids have no concealed surface; that is, they will be seen from either side, depending upon whether the cover is in the open or closed position. Accordingly, appearance standards are equally high on both faces of the part; therefore, punch and cavity must be equally well finished. On the Admiral lids, knockout pins have been eliminated to avoid objectionable marks on the cover. Design of the parts is such that they have sufficient draft to permit their removal from the cores without difficulty by the press operator.

To facilitate the molding operation, each mold is loaded with a single brick-type preform weighing 1340 g. or just under 3 pounds. The preforms are preheated in a 5 kw.-Illitron electronic preheater, preheating time being about the same as the molding cycle. The operator places one preheated preform on the punch of the lower die and the other in the cavity of the upper die. The molds close rapidly and the total molding cycle is about 2½ minutes. Molding pressure used for these parts is only 300 tons as compared with 600 tons (and a larger press) which would be necessary if the molds were placed side by side.

Driven Inserts

At the end of the cycle, the operator removes the two parts, blows out the molds, inserts the next pair of preforms, and closes the press. While the molding cycle is in progress, he removes any edge flash from the parts with a file and drives two internally threaded inserts into cored bosses in each cover. The use of a step tool for this operation insures that the inserts are correctly positioned, with the top surface flush with the face of the cored openings. With this type of insert, applied after the parts have been removed from the press, the cycle is not delayed while inserts are placed in position in the mold. The brass inserts are knurled on the outside and, because they are driven into the holes while the material is still hot, subsequent shrinkage around them insures that they will be permanently gripped in position. Inserts after installation will withstand a 40 ft.-lb. pull.

Cooling Fixtures

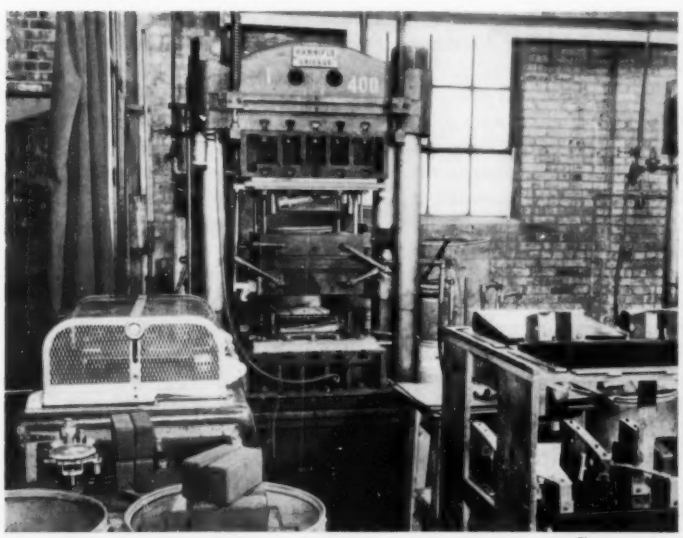
The covers are then held for a short time on metal cooling fixtures with padded weights to maintain accurate dimensions and guard against warpage. This is necessary to assure a close fit with the main body of the radio-record player housings. The fixtures are constructed so that they hold all four edges of the lid in alignment and also support the curved top of the piece from beneath. After removal from the cooling fixtures and subsequent inspection, the covers are ready for assembly to the base sections.

Successful operation of "twinned up" molds in this set-up for producing thermoset pieces of relatively large area is indicative of molding economies that can well be applied to similar compression molding jobs. When molds can be designed for "twinning," "sandwiching," or "stacking," so that multiple parts can be produced in one molding cycle without demanding excessive platen area and pressures in the molding press, the cost of producing such parts can be materially reduced.

CREDITS: Molder, Molded Products Div., Admiral Distributors, Inc., Chicago, Ill. Press, 400-ton Hannifin. Phenolic molding material, Plastics Engineering Co., Sheboygan, Wis.

PRODUCTION

Placing molds one above the other in compression molding results in economy and speed without increase in press size



Photos courtesy Admiral Corp.

Production set-up for stacked molding of lids: equipment for preheating brick-shaped preforms is at left, 400-ton press in center, cooling fixture at right

Lids are removed from press at end of cycle; lower piece has been lifted off punch, upper piece is still in cavity

Papers given at Film, Sheeting, and Coated Fabrics Conference stress salesmanship, upgrading, standards, markets, new polymers

YOU CAN'T make people buy what they don't want. The old fashioned salesman who could sell refrigerators to Eskimos is as dead as the dodo. Modern selling is low pressure, consists of making the customer want your product so much that he asks for it.

Keynote—In such style did **Robert S. Wilson,** vice president and sales manager of **The Goodyear Tire and Rubber Co.,** keynote the Fifth Plastics Film, Sheeting, and Coated Fabrics Div. Conference of The Society of the Plastics Industry at the recent New York meeting.

Mr. Wilson also emphasized the importance of sales research. "Every producer should know first-hand why his product is not selling as well as his competitors'," he said. To help ascertain what is going on in the field he suggested that manufacturers integrate salesmanship with every stage of the corporate cycle from product concept and development on through to the satisfied smile on the face of the ultimate consumer. The salesman's knowledge of the customer needs to be shared with research, production, engineering, and finance. On the other hand, the salesman's knowledge of his product and its potentialities needs to be shared more fully with the customer. "The old cliche, 'the customer is always right,' is just not true," said Mr. Wilson.

Commercial Standards

Evidence that the vinyl film industry hopes for continued progress by providing its salesmen with a better product to sell was given by **J. A. Price, Bakelite Co.,** chairman of the Vinyl Film Standards Educational Committee of S. P. I., who pointed out that higher quality material will be developed to establish new markets. He thinks it is possible to double production if present standards and techniques are reasonably upgraded. Mr. Price, like almost everyone else at the Conference, implied that the industry's Commercial Standards should be steadily improved now that a start has been made toward guaranteeing that purchased film will meet certain specifications.

Among the tangible results that have followed adoption of Commercial Standards C.S. 192-53 is that two of the nation's largest variety store chains have notified suppliers that they will accept only such vinyl merchandise as meets the specifications. The next step will be end-product standards.

Enlarged Markets—Further comment on how vinyl film standards, if made worthwhile, can contribute to enlarged markets was made by **E. Raymond Corey,** assistant professor at the Harvard Business School. He thinks that perhaps the most hopeful sign for the future is that so many diverse interests as resin producers, film producers, fabricators, and retailers can all act together and settle on a method for determining quality standards. He warned that it is this common interest, or lack of it, that can spell success or failure in providing end products which will result in consumer satisfaction.

The essence of Mr. Corey's remarks was that a "Quality Seal" must denote quality. And the "quality" must extend beyond the film itself. Nothing that is printed on a tag will make a customer buy a second $1.98 plastic raincoat if a seam on the first one pulls out. He probably wouldn't even buy a higher priced one in plastic. Fabrication, styling, and the proper thickness to do a good job for a specified purpose must be considered. Styling, design, and price alone may make a customer satisfied with vinyl drapes because the price, compared with other materials, is so low that she considers the drapes to be expendable. But, on the other hand, she will consider vinyl upholstery a catastrophic failure if it tears out on an overstuffed chair. Weavers of high grade fabrics handle this problem by insisting that their materials go into suits and other end uses in which every other aspect of quality, such as that of tailoring, is also high. Vinyl resin and film producers may do likewise.

Reputation Important—"Perhaps the toughest problems of all," said Mr. Corey, "are to make the customer realize that there are all kinds of vinyl products and to prevent the poor reputation of one from hurting the reputations of all others." The problem is not to prevent the sale of inexpensive merchandise, but to help

the customer understand that she is getting what she pays for. If she wants better performance she must expect to pay a somewhat higher price.

Another warning voiced by Mr. Corey was that the vinyl industry must not expect to continue to grow at the same fantastic rate as in the late 40's and early 50's. He pointed out that annual sales of vinyl film increased over 300% from 1948 to 1953 even though there was a declining market in the last three years of this period. In the same years, sheeting increased 250% and coated fabrics about 300 percent. But over the same period, consumer disposable income increased only 48% and expenditures on durable goods only 27%. Obviously, the vinyl industry can't expect to run so far ahead of general purchasing forever. In future days the vinyl film and sheet market is likely to be more clearly determined by economic conditions, but it is quite possible that the vinyls may continue to increase at a greater rate than the general economy for some years to come. This assumption is based, of course, on development of new markets and a constant improvement program in the quality of vinyl goods offered.

Among the tangible results of the adoption of commercial standards is that two of the nation's largest variety chain stores will now accept only such vinyl merchandise as meets the specifications.

Wall Coverings

The subject of new and expanding markets was highlighted by a number of speakers at the meeting. **A. G. Whyte, U. S. Plywood Corp.**, delivered a most unusual plea. In effect, he asked that manufacturers of lightweight, low-priced vinyl wall coverings get out and do more business in the almost unexploited domestic and semi-commercial field, so that producers of both light- and heavy-duty vinyl wall coverings can enjoy more business. There has been a trend, he indicated, toward attempts to make light-duty material serve in commercial or industrial applications where it is unsatisfactory. Failures and a prejudice in the mind of the buying public against any kind of vinyl have been the result.

Potential Field—There is a tremendous potential field for vinyl wall coverings in both light- and heavy-duty grades. About $10 million worth was sold in 1954—the 1960 market could easily reach $50 million. The greatest portion of this market is open to manufacturers of lighter-gage sheets and coated fabrics if they will only go after it, but if they insist on trying to put light-gage material where heavy-gage belongs, only trouble and confusion will result, according to Mr. Whyte.

He emphasized that distribution should be handled by wall paper houses because they are the natural outlet for the product. In his own field of heavy-gage vinyl, exclusive distributors have been by far the most successful. The company has 46 distributor units, 5 field sales personnel, and over 40 architectural service representatives. Obviously, such an organization is expensive to maintain and must turn in large volume business to make it worth while; in this case, the special architect service accounts for 75% of the company's wall covering sales. This market is one where any mistake or product failure must be remedied to the entire satisfaction of both the architect and the client if repeat business is to be enjoyed and increased acceptance stimulated.

Adhesives Developed—It has not been an easy market to conquer. The adhesive problem required four years of research before it was solved. Clear 22-mil vinyl has a tremendous elastic memory which for a long time defied the most tenacious adhesives. The resulting open seams —it always seemed that they occurred in the most prominent and highly publicized installations—cost thousands of dollars in replacement jobs before a satisfactory adhesive was developed. Problems in hanging, staining, designs that don't match, jurisdictional labor problems, and many others were listed by Mr. Whyte as existing obstacles that must be overcome.

Nevertheless, the market for all types of vinyl wall covering is destined to grow because its good properties outweigh the troublesome factors. Furthermore, producers of wall coverings can avail themselves of a sales area more accustomed to higher product pricing than many others in the vinyl film and sheeting or coated fabric field.

Agricultural Uses

Development of markets for film and sheeting in the agricultural and industrial field were outlined by **Eli A. Haddad, Monsanto Chemical Co.**

He listed silage covers as the greatest agricultural use so far. Resistance to silage acids is a primary advantage of vinyl, but the film must be specially compounded for both acid and temperature resistance. Vinyl adhesive tape is often used as the bonding medium; electronically sealed sections are higher in cost.

Other agricultural or horticultural uses for film are covers for hay; waterproofing bench liners in greenhouses; covers for steam sterilization of soil; covers for chemical fumigation; covers for cotton bales; shades to control growth of flowers; and temporary construction to supplement greenhouses. A new development is "dewdrop-proof" film, used to protect the foliage of some plants that are prone to certain types of disease when wetted. Incorporating a humectant in the film has shown promise of eliminating this problem.

Industrial Uses

More vinyl is going into industrial uses. Among the better known products are pressure sensitive adhesive tapes. Approximately 8 million lb. of such tape was used in 1954, principally for electrical purposes; but the tapes are also gaining stature as pipe wrap, floor marking material in factories, and decorative uses in the home such as shelf edging.

The future vinyl film and sheet market will be determined by economic conditions, but it is quite possible that vinyl production may continue to increase at a greater rate than the general economy for some years to come.

Other industrial uses for vinyl film are as a facing material for fibrous glass insulation, to replace tar paper in pouring concrete floors and basements, as a dust barrier on the sub-

(*To page* 224)

PLASTICS

Shoe Size Indicator

Measuring device for childrens' shoes, called Micro-Fitter, with parts of molded nylon, is less than 6 in. long and is designed to provide accurate length and width measurements of a child's foot. In addition, the Micro-Fitter can be used to measure the size (inside) of childrens' shoes to show the exact amount of toe room which the shoe provides.

The unit consists of two parts: a base and a sliding rule. The base, which includes a heel rest, incorporates a channel through which the sliding rule can be moved. Calibrations on both the base and the sliding rule give the size information. Molded-in lugs on the sliding rule, insure easy operation of the slide.

Micro-Fitter is produced in a 4-oz. injection molding machine using a two-cavity mold. All letters are depression molded and then wiped in with paint. The unit is available with red, black, blue, green, amber, and white base with a white sliding scale.

CREDITS: Manufactured by Del Pesco Systems, Inc., Box 609, Danielson, Conn. Nylon supplied by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Clip-on Food Tray

Designed to eliminate the problems of how and where to serve food in the recreation or living room, a tray called Clip-Grip Chair Tray has parts molded of C-11 and medium high-impact styrene. It can be attached to a chair or sofa arm to serve as an extra table, being held securely in place by means of chrome-plated tension springs which maintain pressure on the legs. When not in use, the legs fold flush against the bottom of the tray so that each unit can be conveniently stored in a minimum of space.

The tray is molded of C-11 on an 8-oz. injection molding machine with extended nozzle, using a one-cavity mold. The legs are injection molded of styrene on a 3-oz. machine using a two-cavity mold. The unit is assembled by sliding a tension spring over a steel rod by which the legs are joined to the tray. The rod is then inserted in holes, cam-cored during molding, in the tray and legs.

CREDITS: Molded by Thomas Mfg. Corp., 80 Clinton St., Newark, N. J. C-11 supplied by Bakelite Co., New York, N. Y. Styrene supplied by The Dow Chemical Co., Midland, Mich.

PRODUCTS

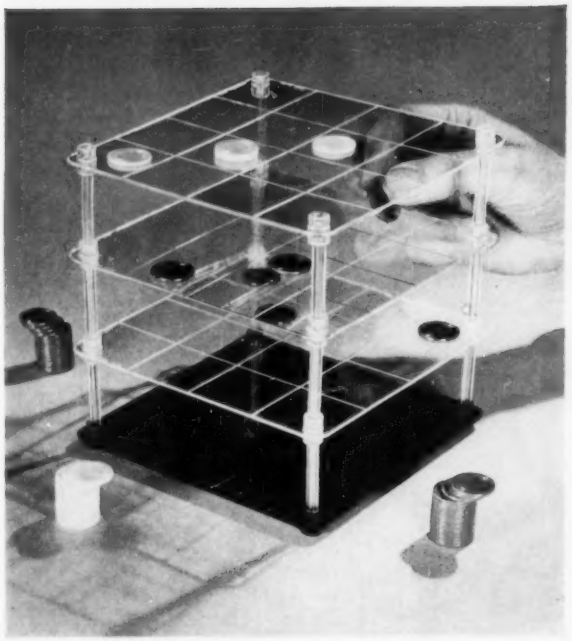
Modern Tic Tac Toe Game

A three-dimensional version of the old game of Tic Tac Toe, called Qubic, is molded of styrene and consists of four platforms, 12 supporting posts, and 60 styrene chips. The parts are supplied as separate pieces and assembly of the game is started by inserting four posts into molded-in recesses located at each corner of one of the platforms. Then another platform is added, four additional posts are set in place and the process is continued until all four platforms are assembled.

Purpose of the Qubic game is to get four chips in a row in one of five directions; either straight across, diagonal, up or down, slanting, or from corner to corner through the cube. Two, three, or four people can play at one time, and the game is designed for the enjoyment of young and old.

Parts for Qubic are produced in an 8-oz. injection molding machine, two multi-cavity molds being used.

CREDITS: Molded by Berkshire Plastics Co., E. Longmeadow, Mass. for Qubic Games, 54 Warner St., Springfield, Mass. Styrene supplied by Monsanto Chemical Co., Springfield, Mass.

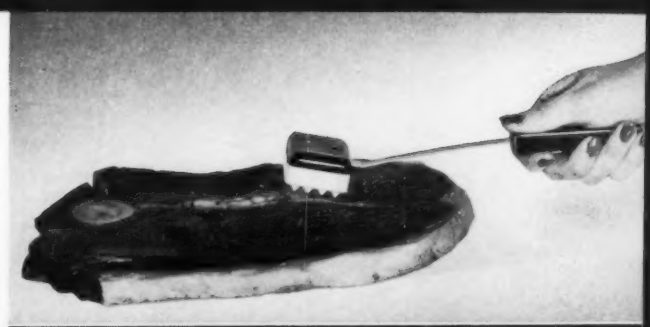


Sanitary Meat Tenderizer

Called Chef's Tender-Aid, a new meat tenderizer has a head molded of cellulose acetate and a stainless steel spring shaft. Purpose of the device is to break down tough fibers without crushing the meat, so that low-cost cuts of meat become tender. In the Chef's Tender-Aid, the mechanical work is largely done by the spring shaft; a mere flick of the wrist causes the cellulose acetate pounding head, which is virtually non-porous and will not absorb meat juices, to hit the meat with great force. The unit, with its 24 molded-in cleats, can be rinsed clean in water.

The tenderizer is molded on an 8-oz. injection molding machine using two molds. The cleated head surface is produced in a four-cavity mold; four top parts for the heads and four complete handles are produced in a 12-cavity mold. The component parts are joined to the spring shaft by means of four stainless steel rivets.

CREDITS: Molded and manufactured by The Standfast Products Co., 2146 Murray Hill Rd., Cleveland, Ohio. Cellulose acetate supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.



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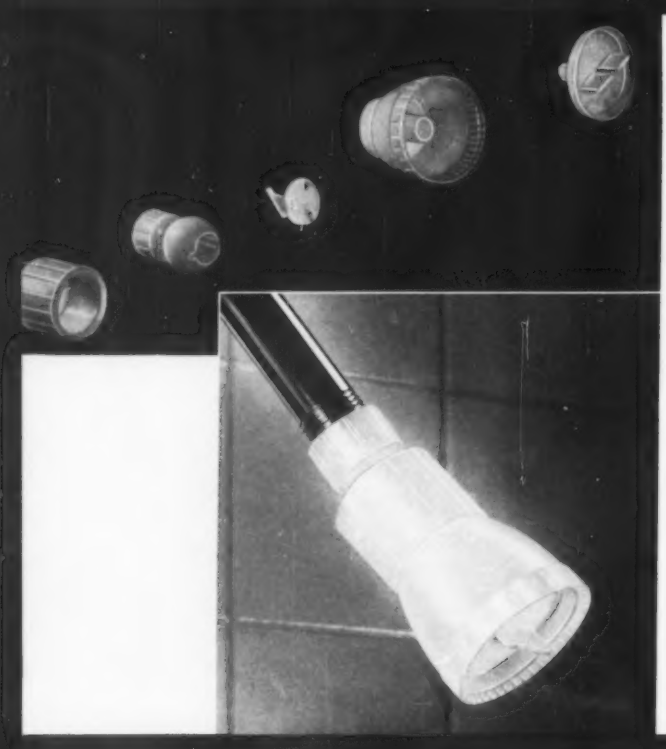


Molded Nylon Shower Head

The possibilities of corrosion or building up of lime deposits, common in conventional shower equipment are practically eliminated in a new molded nylon shower head called Nylon Maid. Nylon has no chemical affinity for lime particles usually present in hard water, and the smooth surface of the unit resists mechanical build-up in the shower head. The head is so designed that the force of the shower stream can be regulated at the head itself by turning it in either direction; in addition, the size of the water jets can be adjusted by turning the spreader plate. Provision of a standard thread makes it possible to mount the Nylon Maid on any threaded ½-in. pipe fixture.

The nylon shower head is produced in a 4-oz. injection molding machine using a five-cavity family mold. After the molding operation, all parts are machined, threaded, tapped, and assembled.

CREDITS: Molded by Rainbow Plastics, Elmonte, Calif. for Warren-Magnuson Co., 612 E. Alosta Ave., Glendora, Calif. Nylon supplied by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Tent-Wading Pool

In a matter of minutes, a child can convert a new combination play unit from a tent into a wading pool or vice versa. Fabricated of 3½-, 8-, and 12-gage vinyl film, the wading pool-tent combination, called Big Top, comes complete with a rope for hanging, three decorative pennants, and a repair kit. When air is forced into the inflatable bumper ring which encircles the tent-wading pool, Big Top assumes a circular shape. Air is introduced through a vinyl valve and an attached plug prevents it from escaping.

The tent measures 42 in. wide and 43 in. high when suspended. Converted to a wading pool, it will hold approximately 50 gal. of water.

The inflatable ring and wading pool bottom, which also serves as the tent top, are of 12-gage material. The tent sides are 8-gage, and the decorative trim is 3½-gage vinyl. All seams are electronically sealed. Valve assembly is injection molded in a 24-cavity mold.

CREDITS: Manufactured by Snyder Manufacturing Co., Inc., 1458 Fifth St., N. E., New Philadelphia, Ohio. Vinyl film supplied by Monsanto Chemical Co., Springfield, Mass.

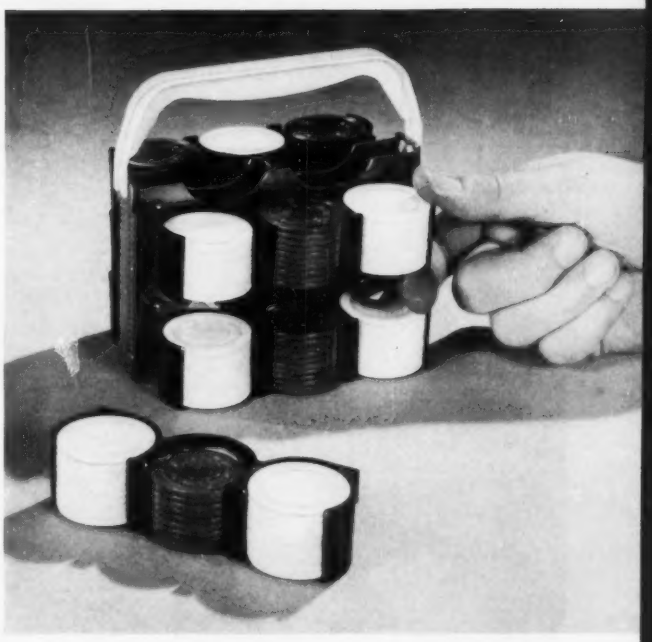
PRODUCTS

Removable-Tray Chip Rack

New type poker chip rack called Handy Ante can serve six players with chips in removable trays. Molded of high-impact styrene, the Handy Ante consists of a rack frame with a double handle, and six trays, each containing an assortment of 30 standard red, white, and blue interlocking chips. The trays slide into place in twin channels, one on each side of the rack frame, which form tracks to accept molded flanges on the backs of the trays. The trays are removed by simply lifting them until clear of the channels. The folding handles serve a double purpose: to carry the rack and, when the handles are down, to lock the trays and chips in place. The center section of the rack will hold two decks of cards.

The Handy-Ante is injection molded in an 8-oz. machine using three multi-cavity molds. The chip trays are produced in a 12-cavity mold; a six-cavity mold is used for the frame halves; and the handles are produced in a three-cavity mold.

CREDITS: Manufactured by Synthetic Plastics Sales Company, 461 Eighth Ave., New York, N. Y. Styrene supplied by The Dow Chemical Co., Midland, Mich.

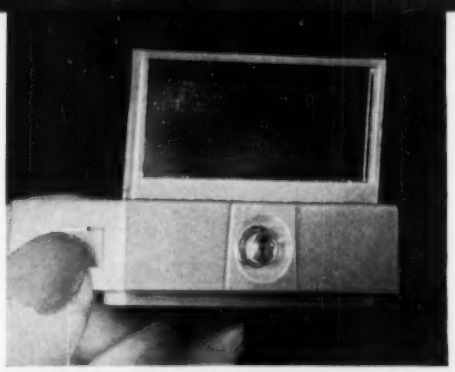


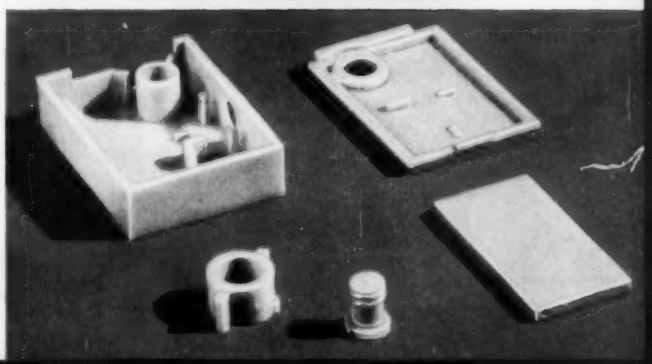
Lipstick Light With Mirror

How to apply lipstick in a darkened theatre or automobile is a problem which has been solved by Vanity-Lite, a purse-size combination lipstick mirror and flashlight. The unit consists of five component parts molded of styrene, plus two batteries, a bulb, and the necessary metal contacts. The bulb directs a concentrated beam of light to illuminate the lips, which are viewed in a hinged mirror mounted on the housing. When not in use, the mirror folds flat against the housing.

Three multi-cavity molds are used to produce the five plastics parts. The case and cover are produced in an 8-oz. injection molding machine using a 12-cavity mold. A screw thread in a recess in the case is formed by an automatic unthreading core driven by a rack and pinion. The mirror frame is produced in a four-cavity mold, with parts automatically degated within the mold. Screw and switch lever are molded in an eight-cavity combination mold.

CREDITS: Manufactured by Bantam-Lite Sales Corp, 79 Fifth Ave., New York, N. Y. Styrene molding compound supplied by The Dow Chemical Co., Midland, Mich.





Air Conditioner Cabinet Front
Courtesy: Philco Corporation

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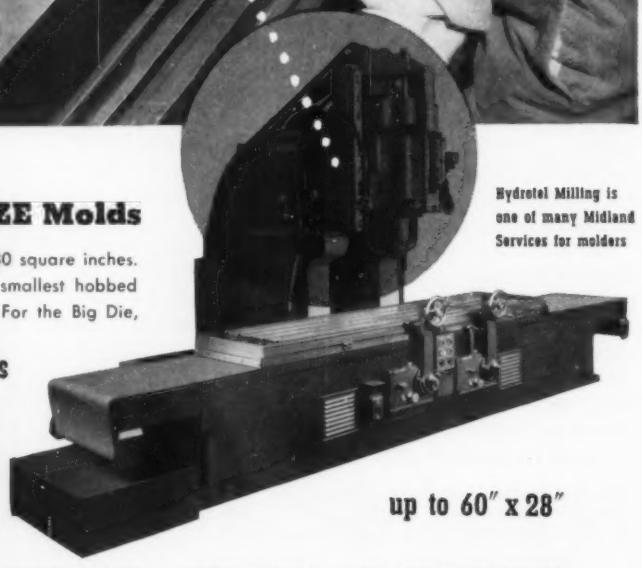

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F. B. Stanley, Engineering Editor

When and How to Hob

Fig. 1—Master hob (left) and hobbing (right) for a gas range temperature control knob. Hobbing has been found to be a more satisfactory method of producing cavities that have raised designs, numerals, or letters than machining operations

All illustrations courtesy Newark Die Hobbing and Casting Co.

Analysis of mold hobbing methods reveals economic advantages. Machining can often be combined with hobbing to produce low-cost multiple cavities

by ISLYN THOMAS† and EDMUND SPITZIG‡

WHEN production economies indicate the advisability of using multi-cavity molds for turning out a given plastics part, the method selected for making such molds can greatly affect the final per-piece cost. In general, such cavities can be either machined or hobbed. Experience has shown that hobbing, sometimes combined with machining to achieve results not possible with hobbing alone, can insure cavity uniformity and, at the same time, economy of mold production.

This basic problem of mold making is of equal importance to the tool maker, the plastics sales engineer, and the end user. Only if the advantages—and the disadvantages—of hobbing are fully understood can an intelligent evaluation be made of mold making methods for a given project.

The underlying principle of producing multiple mold cavities by hobbing was conceived in about 1876 by Charles Burroughs, Sr., founder of Burroughs Engineering Co. Soon after Hyatt produced Celluloid in 1869, it was found that toothbrush handles, harness buckles, and similar molded items could be produced in fairly large quantities only with multiple-cavity molds and that steel cavities were best suited for the work. However, production of such steel cavities by machining was very expensive because of the hand work involved; also, it was practically impossible to produce individual cavities of uniform size and contour by hand methods.

The hobbing method developed by Mr. Burroughs used a highly polished steel master (called a hob) which, when properly hardened, could be sunk into a piece of cold soft steel through the use of a hydraulic press; the resulting cavity had a surface which was as highly polished as the hob. In addition, it was discovered that the process so compressed the soft steel that the pores of the metal in the cavity were

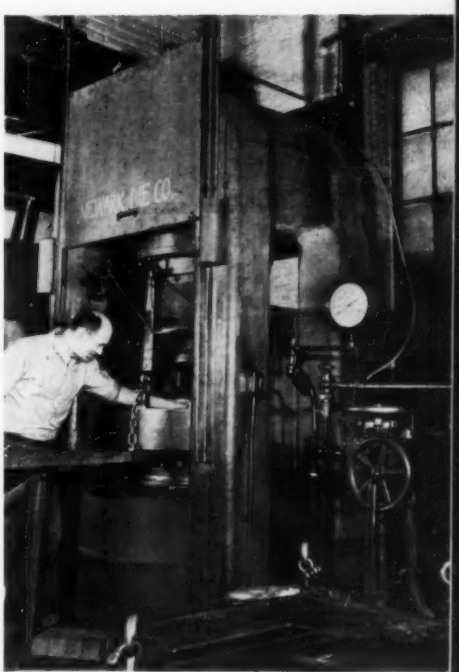


Fig. 2—Late model, rodless-type hobbing press has capacity of 3000 tons

* Reg. U. S. Pat. Off.

† General manager and ‡ Superintendent, Newark Die Hobbing & Casting Co., Newark, N. J.

Fig. 3—Rectangular and circular hobbing rings (one held by operator) are used to support hobbing blanks, prevent spreading away of blanks from hobs under pressure

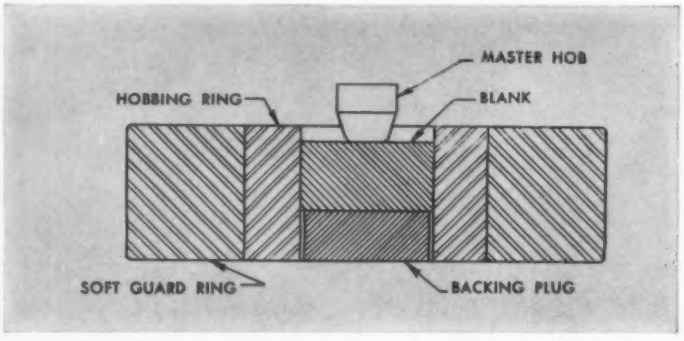


Fig. 4—Diagram shows location of hobbing ring, master hob, hob blank, soft guard ring, and backing plug; hobbing rings are made of hardened chrome nickel steel

considerably diminished in size. In other words, the surface of the hobbed cavity exhibited a finer grain. Also, many mold cavities could be produced from the master hob, each one unvarying in size and having uniformly polished surfaces.

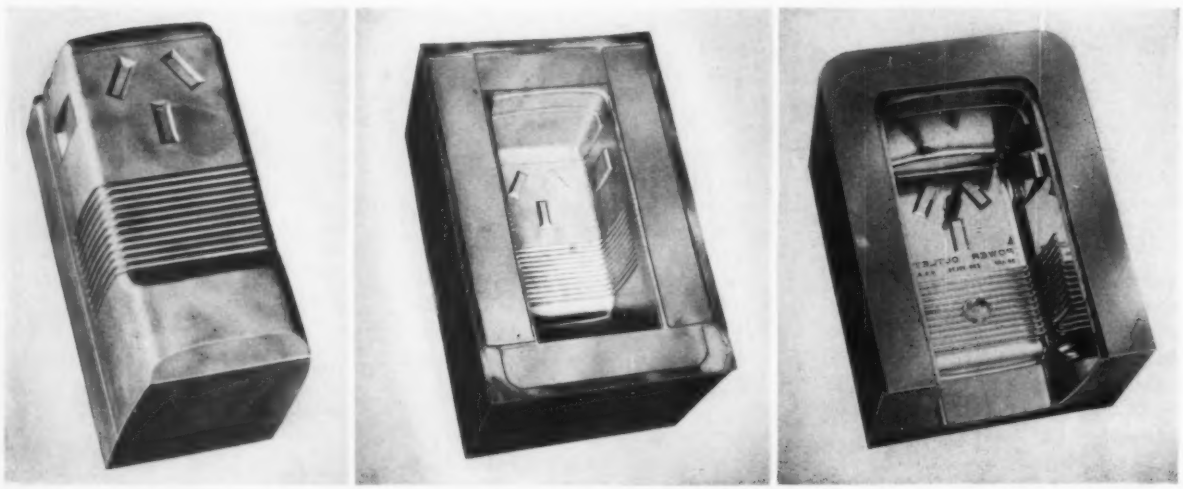
Hobbing has undergone no basic change since 1876, but many improvements had to be made in equipment, in hobbing steels, and in techniques to meet the tremendously increased demand for mold cavities of larger size, with closer limits, and in shapes unheard of in the early days of the plastics industry.

Procedure

Cavities are often machined when they should be hobbed, and hobbed when they should be machined. This situation is due not only to a lack of the necessary specialized hobbing equipment, but also to unfamiliarity with hobbing techniques. Many pieces are difficult to hob because of bosses, shoulders, and thin sections.

Several variables must be considered before determining whether a certain cavity should be machined or hobbed. The number of cavities to be made, availability of equipment, necessary uniformity between cavities, and quality required in the finished article, must all be taken into account before a reasonable decision can be reached.

In some cases, the best procedure is a combination of machining and hobbing. At other times hobbing is



Figs. 5 (left), 6 (center), and 7 (right)—Hardened steel hob in Fig. 5 has all details required on molded plastic electrical control housing, except certain lettering which has to be raised on the molded part. Semi-finished hobbing, after it has been squared up, is shown in Fig. 6. Finished cavity (Fig. 7) has one end cut away. This opening cannot be hobbed and, therefore, must be machined. The depressed lettering in the hobbing is produced by the use of an engraving machine

the only satisfactory method of producing multiple cavities. This is particularly true of dies having raised designs, numerals, or letters (Fig. 1).

Hobbing Press

Because of the tremendous growth in demand for hobbed cavities of all shapes and sizes, hydraulic hobbing presses have increased in size and capacity from approximately 50 to 8000 tons. One of the latest models (Fig. 2) has a capacity of 3000 tons. Its frame is a one-piece steel casting with cylinder, tension members, and top head combined in an integral unit. Anvils, or wearing plates, are mounted on the top of the ram and on the top of the press. Accurate machining assures that these members are parallel when assembled. Since the press frame is in one piece and there are no nuts to loosen in operation, this relationship is maintained throughout the entire life of the press.

Operation of the press shown is controlled by two hand wheels. When hobbing a cavity, the hardened hob is placed in position on top of the soft steel blank. The ram moves under low pressure until it comes in contact with the back of the hob. At this point, due to the resistance set up by the hob pressing against the blank, the low-pressure pump is by-passed and the high-pressure side comes into action.

Hobbing Rings

When the high pressure is exerted, hobbing rings, or chases as they are sometimes called (Fig. 3), support the soft hobbing blank and keep it from spreading away from the hob while under pressure. Hobbing rings, which are made of hardened chrome nickel steel, are generally supported on the outside by a soft steel guard ring as shown in Fig. 4. These hobbing rings are not necessarily round; they may also be made rectangular in shape.

In the case of certain molded items of rectangular or oblong shapes, square-cornered chases make possible the use of much smaller hobbing blanks than would be practical if only round hobbing rings were available. Size of the round hobbing rings is determined by the inside diameters of the chases, which may vary from ⅝ to 13 in. or larger. Since the hobbing blank must fit inside the ring, the size of the ring used for a specific job depends upon the size of the hobbing blank.

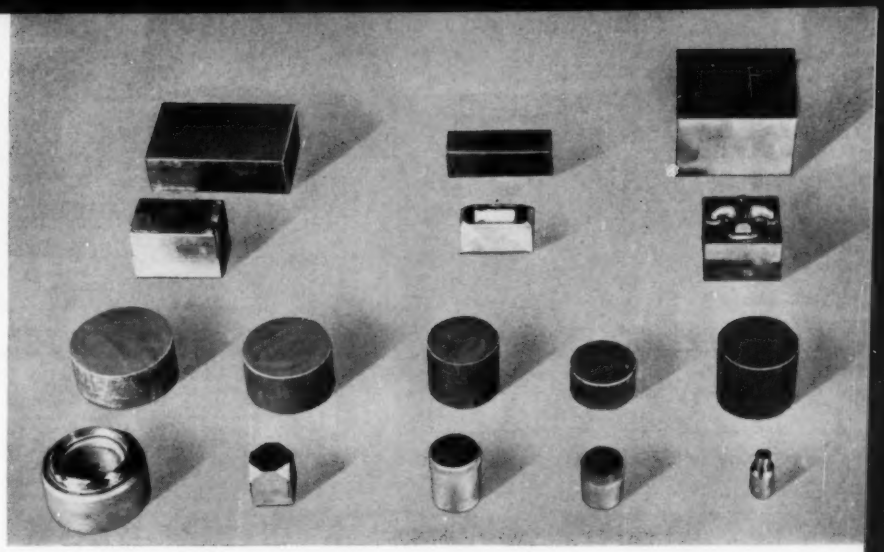


Fig. 8—Hobs and their respective hobbing blanks. Hobbing blanks are made from special hobbing steel and generally annealed between squeezes to relieve stress

Round and squared hobbing rings are divided into two more groups, according to whether the center hole is straight or tapered. The tapered ring, which is limited to special jobs, is used to control the flow of metal toward the hob.

Hobs

The hardened steel hob (Fig. 5) is so shaped that its form and dimensions (with allowances for shrinkage of the plastics material) are an exact duplicate of the plastic part to be molded in the cavities. The hobbed cavity (Fig. 6) is then a true negative replica of the hob. In cases where certain features of the article to be molded must be left off the master hob, the cavity is machined after being hobbed (Fig. 7).

While the design of mold cavity hobs varies from one shop to another, there are some fundamental facts which should not vary. These include the incorporation of as many fillets as possible, elimination of sharp corners, use of maximum permissible taper or draft which should be a minimum of 0.005 in./in. per side, highly polished surfaces, and no undercuts. The hobs shown in Fig. 8 give an idea of the large variety of shapes that can be produced.

Steel for Hobs

In the selection of steel for the hob, machining characteristics, minimum distortion in hardening, depth of hardness, compression strength, and the combination of substantial hardness with toughness, must be considered. An oil-hardening chrome-tungsten-vanadium steel is well suited for the making of a hob and, if properly hardened to C-58 to 60 Rockwell and well polished, it will stand up under heavy hobbing pressure. A typical analysis would be as follows: carbon, 0.45; chromium, 1.25; tungsten, 2.75; vanadium, 0.25 percent.

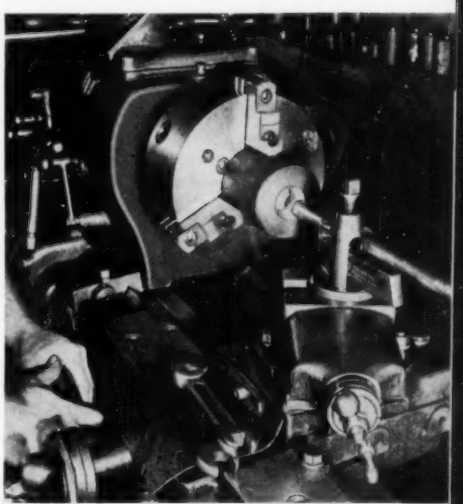
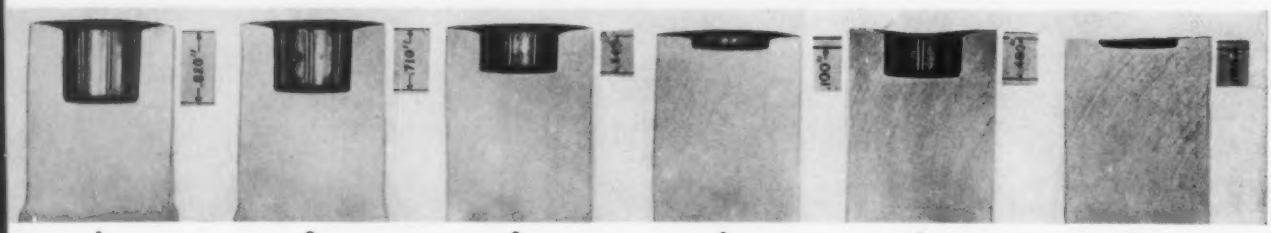


Fig. 9—Removing metal from bottom of blank lowers hobbing pressure needs

An additional consideration should also be given to the number of hobbings to be made with each hob, in order to take full advantage of the inherent economics of cavity hobbing. It is of utmost importance that the steel for each hob have the desired surface hardness, wear resist-



1 2 3 4 5 6

Fig. 10—Hobbing results with different alloy steels subjected to identical hobs and pressures: 1—low-carbon iron; 2—chrome alloy steel; 3—5% chrome Mo-V alloy steel; 4—chrome stainless steel; 5—1.3% nickel, 1.7% chrome; 6—3.8% nickel, 1.8% chrome

Table I—Comparative Hobbability of Steels

Designation	Brinell	Depth of Cavity
		in.
V-iron	84	0.82
2.3% chrome	95	0.71
1.3% Ni, 0.70% Cr	116	0.48
5% Cr Mo-V	118	0.44
0.90% C steel	170	0.11
1.10% C steel	166	0.11
13% Cr stainless	170	0.10
3.8% Ni, 1.8% Cr	196	0.08
0.70% C, Mn-Cr-Mo	223	0.04

Mold blanks 1.75 in. dia. by 2.25 in. long; no bottom relief; retainer ring 1/4 in. off platen; hob 0.910 in dia., tapered 0.045 in./in.; load 113 tons, one application.

ance, strength, and toughness for the work to be done. Compressive stresses to which hobs are exposed sometimes become very high. In order to retain dimensional accuracy of the hob, and long hob life, hobbing pressures should not exceed 145 to 160 tons per sq. in. for the hardest hob steels, and 110 to 120 tons per sq. in. for hob steels that are slightly softer.

Successful hobbing depends to a great extent upon the blanks. These blanks (Fig. 8) are made from special hobbing steels and are generally annealed before they are used. This will help relieve the stresses and insure uniform distribution of the carbides. The selection of the proper steels is of extreme importance and the following factors should be borne in mind: hobbability, cleanliness, uniformity, machinability, hardenability, wear resistance, strength, and ability to take a high luster when polished.

In general, one mold steel cannot meet all of the requirements and a compromise must be found. The following condensation shows the properties which mold steel should possess.

It should be free from foreign matter and contamination so that it may easily be hobbed and produce a good surface. It should be soft as supplied and should not harden too quickly upon hobbing. It should flow only slightly under hobbing pressure. Good flow properties are of utmost importance since the master hob should be exposed only to certain stress limits. The problem of high hobbing pressures cannot be solved simply by choosing a bigger press. As soon as a certain maximum pressure has been reached, the blank must be annealed before further pressure is applied. If a relatively soft steel is being hobbed, annealing may be avoided or the number of annealings reduced; this also extends the life of the hob.

Several types of steel have been developed for hobbed cavities. One is a low-carbon case-hardening steel with a maximum Brinell hardness of 100 which is used where ease of flow under pressure is required. A typical analysis would be: carbon, 0.05 to 0.10; manganese, 0.15 to 0.25; phosphorous, 0.03 to 0.05; sulphur, 0.02 to 0.03 percent. This type of steel does not produce a high core hardness but will give a good wear-resisting surface hardness if properly carburized.

When greater toughness and resistance to upsetting is required, chrome-nickel steels are used although greater difficulty will be encountered in the hobbing operation. A typical analysis would be: carbon, 0.10 to 0.20; chromium, 0.45 to 0.75; manganese, 0.30 to 0.60; nickel, 1.00 to 1.50 percent. These alloy steels are generally supplied in Brinell hardness ranging from 120 to about 160. In certain instances it is also possible to hob well annealed tool steel blanks within certain limits despite the fact that this material does not lend itself readily to deep hobbing because of its poor flowing quality.

Fig. 11—Preparatory to hobbing, hobbing ring is set in press, and backing plug and polished hobbing blank placed inside it; hob is then put in position over blank

Preparing the Blank

First step in the preparation of a hobbing blank is grinding and polishing to a mirror-like finish of the surface which comes in contact with the hob. Then, after being fitted to the hobbing ring, the blank is ready

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One of the Stokes 15-ton Model 800 fully automatic molding presses at the Wayne, N. J. plant of Mack Molding Company, Inc. The 800 presses handle all thermosetting plastics, including alkyds without press modification. Cycles are fast, mold cost low.

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F. J. Stokes Machine Company
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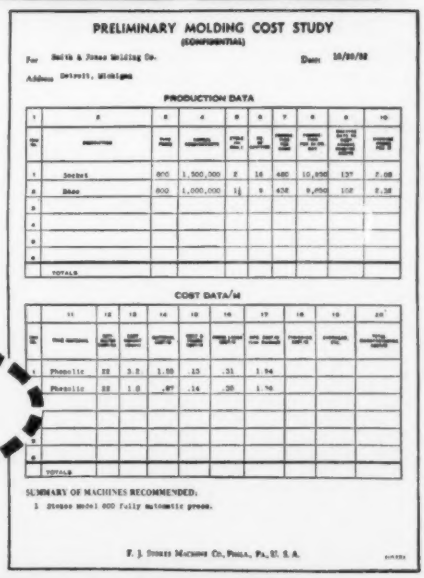


PRELIMINARY MOLDING COST STUDY
(CONFIDENTIAL)

For Smith & Jones Molding Co. Date 10/20/52

Address Detroit, Michigan

PRODUCTION DATA

1	2	3	4	5	6	7	8	9	10
Part No.	Description	Parts per 1000	Material Requirements	Finish Wt.	No. Cavities	Molding Cycle	Number of Parts per hr. per cav.	Machine Time per 1000 pcs.	Machine Cost
a	Socket	800	1,500,000	2	16	40S	10,000	12T	7.08
b	Base	800	1,000,000	1½	9	45S	9,000	10T	8.38
c									
d									
e									
	TOTALS								

COST DATA/M

11	12	13	14	15	16	17	18	19	20
Part No.	Type Material	Mat'l. Cost per lb.	Mat'l. Cost per 1000	Molding Labor Cost	Mold Cost per 1000 pcs.	Total Cost per 1000 Pieces	Assembly Cost	Assembly Mat'l.	Total Manufacturing Cost
a	Phenolic	22	3.3	1.55	.23	.31	1.94		
b	Phenolic	22	1.8	.87	.14	.30	1.16		
c									
d									
e									
	TOTALS								

SUMMARY OF MACHINES RECOMMENDED:

1 Stokes Model 800 fully automatic press.

F. J. Stokes Machine Co., Phila., Pa., U. S. A.

Typical Stokes report on molding cost study of parts to be made by fully automatic molding.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment

for the first push. To help reduce the power needed, some blanks are relieved by removing metal from the bottom as shown in Fig. 9. The amount of steel removed varies from approximately 10 to 60%, depending on the type of hobbing steel, the shape of the hob, and the pressure to be used for the particular application. A good rule of thumb formula for sinking round cavities is to make the diameter of the blank approximately twice the diameter of the hob. The height of the blank should be about two times the depth of the hobbed cavity.

Comparative hobbability of steels is shown in Table I. Various types of alloy steel will react differently when subjected to the same hob and pressures, as shown in Fig. 10.

The depth of 0.820 in. in No. 1, Fig. 10, was achieved in low-carbon hobbing iron. The depth of 0.710 in. in No. 2 was achieved in 2.3% chrome alloy steel. The depth of 0.440 in. in No. 3 was achieved in 5% chrome Mo-V alloy steel. The depth of 0.100 in. in No. 4 was achieved in 13% chrome stainless steel. The depth of 0.480 in. in No. 5 was achieved in 1.3% nickel, 1.70% chrome. The depth of 0.080 in. in No. 6 was achieved in 3.8% nickel, 1.8% chrome. These results show that the Brinell hardness has a definite bearing on the depth of the sinking.

Hobbing Procedure

Although the actual mechanics of the hobbing operation are simple, years of experience are necessary

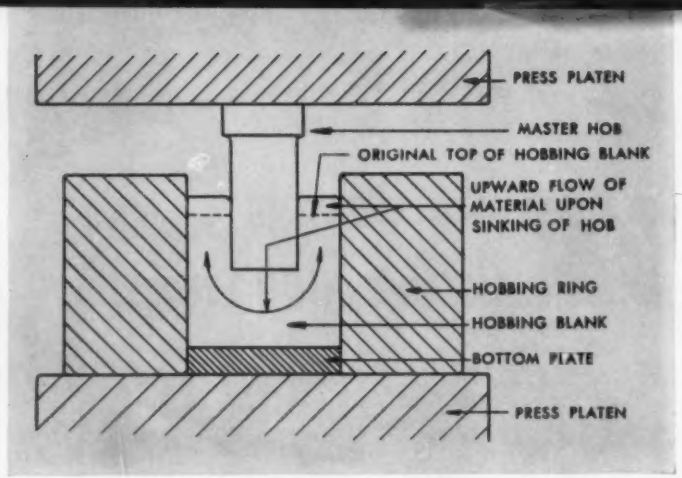
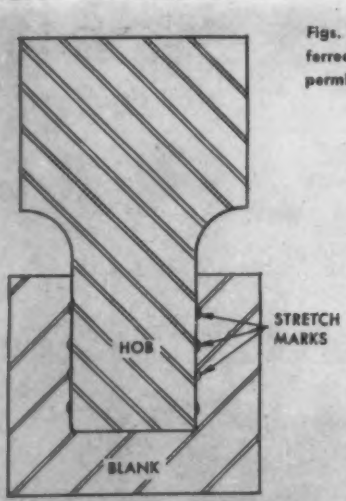
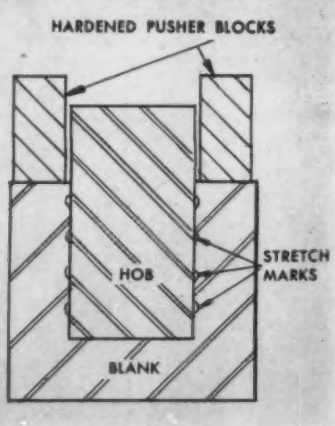


Fig. 12—Diagram of proper hobbing set-up. Hobbing blank is not compressed; instead, volume of material displaced by hob is distributed to other parts of blank

Fig. 13—Hobbed cavities are vapor-blasted with a liquid-suspended abrasive in order to remove oxides and discolorations brought about by earlier annealing operations

Figs. 14 (left) and 15 (below)—Small base is preferred on hobs to be sunk more than ½ in.; it permits pusher blocks to be properly mounted





before cavities of the quality commonly demanded by the plastics industry can be produced with guaranteed consistency.

Upon hobbing, the materials of both the hob and the blank are exposed to very high stresses. The soft steel of the blank must flow under the pressure of the hob without hardening to an extent that further immersion of the hob is impeded or that cracks show up; on the other hand, the tool steel of the hob must withstand high compressive strength without fracturing or deforming to any noticeable degree.

After the hobbing ring is set in the press, the backing plug and the already polished soft blank are placed inside it. The hob is then put in position over the blank (Fig. 11), care

cabinet appointment

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Cabinet manufactured by Jens Risom Design Inc., New York City. Tambour door extruded of Tenite Butyrate.

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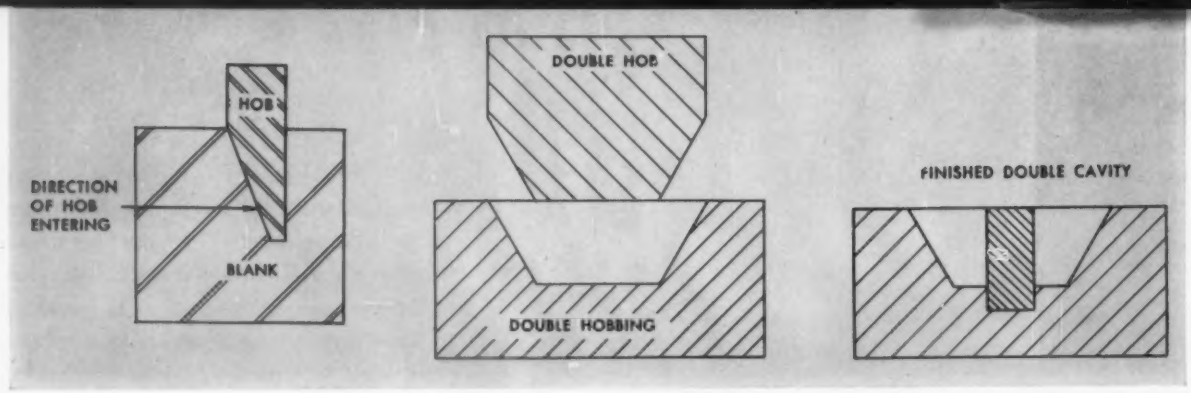


Fig. 16—Use of un-balanced hob to make trapezoid cavity can cause hob breakage

Fig. 17—Correct approach would be to use a balanced double hob and . . .

. . . (Fig. 18) then set a hardened plate in the finished double cavity

being taken that all foreign matter is removed; even a piece of lint between the hob and the blank will be found, at the end of the hobbing operation, to have left its imprint. No oil or lubricant should be used between hob and cavity if an extremely high luster is desired. On those occasions when a lubricant is thought necessary to prevent hob breakage due to excessive friction, blue vitriol (copper sulphate) is generally employed. A solution of 15 oz. of copper sulphate and 5 oz. of oxalic acid in 1 gal. of water has proved satisfactory.

As soon as the ram encounters the high resistance set up when the hob starts to press onto the blank, the low-pressure pump is by-passed and the high-pressure side comes into action. The ram then starts its ascent. Although this movement is very slow, a hobbing or impression may be finished within 45 to 90 sec., the time, of course, depending upon the depth of the impression. As the hob sinks into the blank, the operator watches the pressure gage. Ordinarily, the pressure rises to the maximum required for a particular hobbing and then remains nearly stationary while the hob continues to sink very slowly into the blank. This continuation of the hobbing operation at practically the same pressure indicates that the work is proceeding satisfactorily and that the metal is flowing around the hob (see Fig. 12). This means that the blank is not being compressed during hobbing, but that the volume of material displaced by the hob is being distributed to other parts of the blank. When the pressure rises rapidly it indicates that the hob has stopped sinking. Pressure should be released as soon as this condition is noted, to avoid damage to the hob.

A cavity may be hobbed in one operation but, if the blank offers too much resistance, due to the depth of the cavity, the hob should be removed and the blank annealed and possibly relieved. It may be necessary to repeat this operation several times. Insufficient press tonnage will also make the removal and annealing of the blank necessary before the hob can be sunk to its final depth. A few points variation in the amount of carbon in the blank steel may increase by 100% the pressure required to hob a cavity, and result in poor flowing quality.

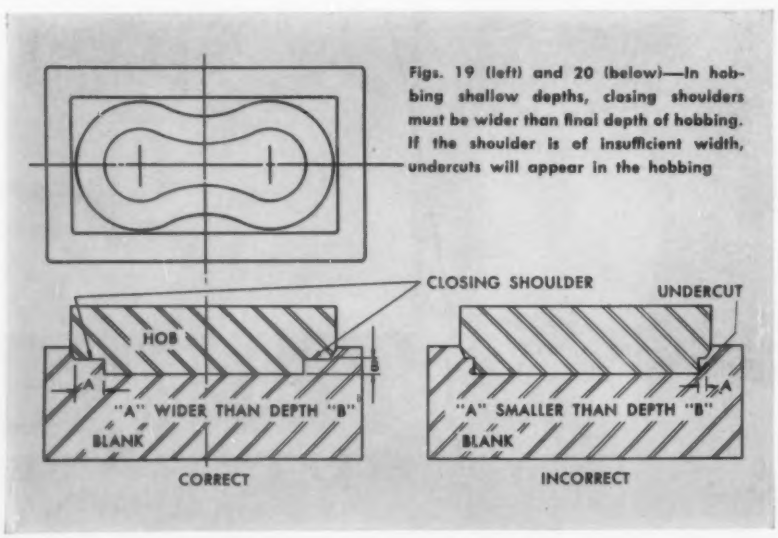
The number of annealings required may vary from one to as many as six. The annealing process involves placing the cavities in steel containers packed with charcoal, sealing the cover with fire clay to exclude air, raising the temperature of the entire unit to 1500° F., then allowing it to cool slowly in the furnace.

Pressure Needed

Pressures required for hobbing ordinarily range from 50 to 200 tons per sq. in. of die impression. The pressure varies not only according to the composition of the steel, but also with the method of hobbing. For instance, if the blank is confined by a chase ring, the pressure may be double that which would be required if the blank were unconfined. In some plants where only small dies or molds are used, a press with 150 ton capacity meets the requirements. In other plants a press capable of exerting a pressure of 1000 or possibly 5000 tons may be necessary.

When the steel blank is being hobbed, it is stretched as well as upset and the cold worked steel becomes harder through deformation to such a degree as to impede further hobbing. As a result, stretch marks

(*To page* 228)



Figs. 19 (left) and 20 (below)—In hobbing shallow depths, closing shoulders must be wider than final depth of hobbing. If the shoulder is of insufficient width, undercuts will appear in the hobbing

Calculating Extruder Performance

Capacity and performance of extruders can be predicted by applying the Simplified Extruder Flow Equation described below

by ERNEST C. BERNHARDT*

IN THE analysis of plastics extrusion problems, it is of great importance to be able to calculate and predict the capacity and performance characteristics of the extruder. In order to define and diagnose extruder troubles, it must first be known what performance a given machine can be expected to give. Recent publications on the theory of extrusion (1,2,3,4)[1] have given new tools and concepts with which these calculations can be carried out. Among the formulas and equations presented in the articles referred to, one is of particular importance and usefulness. It provides an extremely simple and rapid method for calculating the performance characteristics of extrusion equipment. The following discussion will explain this Simplified Extruder Flow Equation, and will demonstrate how to apply it to predict extruder capacity and performance.

Extruder Flow Patterns

To predict the action and performance of an extruder, the flow patterns which occur along the extruder screw must first be understood. The screw is usually divided into three sections: a) feed section; b) compression section; c) metering section (see Fig. 1).

It is the function of the feed and compression sections to melt the extruder feed and to provide molten polymer for the metering section. The feed and compression sections do not lend themselves readily to mathematical analysis, because complicated combinations of dry conveying and viscous flow occur in these zones.

The metering section is the simplest to analyze, because in this zone the stock is melted and it obeys, approximately at least, the laws of viscous flow. The metering section is important to the extruder, because its function is to push the stock through the die, and it usually determines the output characteristics of the machine. The equations which have been derived in the publications referred to above apply only to the metering section of the screw. The Simplified Extruder Flow Equation discussed here also holds true only for the metering section of the screw. To aid in understanding the terms in this equation, it will be helpful to analyze the flow patterns in the metering section of an extruder (Fig. 2).

There are two main flow components: 1) *Drag Flow,* which is the forward conveying action produced by the relative motion between the screw and the cylinder; and 2) *Pressure Flow,* which is the backward flow down the channel length produced by the back pressure at the die.

The output of the metering section is the drag flow minus the pressure flow.

Actually a third flow occurs. The back pressure at the die and the resultant difference in pressure between successive turns of the thread causes a backward leakage between the land and the barrel. Usually this *Leakage Flow* is only a small fraction of the other flows. In the Simplified Extruder Flow Equation, the leakage flow is neglected.

Drag Flow

Drag flow is the forward conveying action produced by the relative motion between the screw and the

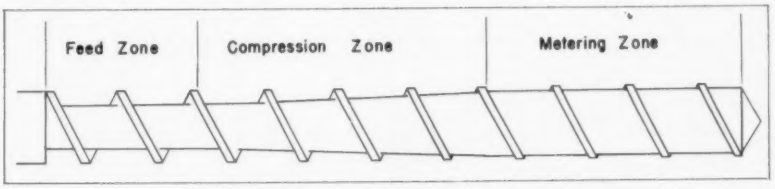
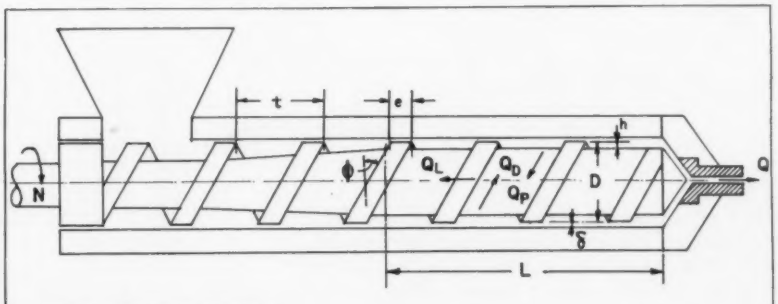


Fig. 1—Schematic diagram of an extruder screw



EXPLANATION OF SYMBOLS:

Q_D = DRAG FLOW	N = SCREW SPEED	h = CHANNEL DEPTH
Q_P = PRESSURE FLOW	t = LEAD	ϕ = HELIX ANGLE
Q_L = LEAKAGE FLOW	e = LAND WIDTH	D = SCREW DIAMETER
Q = OUTPUT	δ = RADIAL CLEARANCE	L = LENGTH OF METERING SECTION

Fig. 2—Schematic diagram of metering section (L) of an extruder

* Sales Service Lab., Polychemicals Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

[1] Numbers in parentheses link to references at end of article, page 229.

cylinder. This can be illustrated very simply by considering an extruder which is cut off immediately following the metering section, so that there are no screen packs or die and the stock is allowed to drop out of the screw at the extruder head. Then the "die pressure" is zero and there is no pressure flow. The material will be conveyed by the action of the lands of the flight upon the material being sheared between the stationary surface of the barrel and the moving surface at the root of the screw channel.

The factors which will influence this drag flow capacity are: channel depth (h); channel width expressed by the helix angle (ϕ); screw speed (N); screw diameter (D).

Pressure Flow

Pressure flow has been defined as the backward flow down the screw channel produced by the back pressure at the die. To illustrate this type of flow, assume that the screw is stationary, but that there is a melt under pressure at the die. The type of flow which will be set up becomes immediately apparent. The screw channel will act like a very long rectangular orifice, and the melt will travel backward down the helical channel, using up the pressure in liquid friction. It becomes apparent that pressure flow will be influenced by these factors: channel depth (h); channel width expressed by helix angle (ϕ); extruder diameter (D); metering section length (L); melt viscosity (μ); back pressure (P).

Simplified Equation

In the "Symposium on the Theory of Plastics Extrusion" (1), simplified formulas for making rapid calculations for drag flow and pressure flow have been presented.

Drag Flow:

$$Q_D = \frac{\pi^2 D^2 N h \sin\phi \cos\phi}{2} \qquad \text{Eq. 1}$$

Pressure Flow:

$$Q_P = \frac{\pi D h^3 P \sin^2\phi}{12\mu L} \qquad \text{Eq. 2}$$

The total output of the extruder then becomes:

$$Q = Q_D - Q_P \qquad \text{Eq. 3}$$

$$\text{or } Q = \frac{\pi^2 D^2 N h \sin\phi \cos\phi}{2} - \frac{\pi D h^3 P \sin^2\phi}{12\mu L} \qquad \text{Eq. 4}$$

Equation 4 is the Simplified Extruder Flow Equation.

It will be helpful to suggest a convenient system of units for these symbols: Q—(output) cu. in. per sec.; D—(screw diameter) in.; N—(screw speed) r.p.s.; h—(channel depth) in.; L—(length of metering section) in.; ϕ—(helix angle) degrees; P—(pressure at die) p.s.i.g.; μ—(melt viscosity) lb. sec. per sq. inch.

The Simplified Extruder Flow Equation will give output figures in volumetric units. Since gravimetric units are usually preferred in practical applications, a plot is presented showing the melt densities of several plastic materials over a range of temperatures (Fig. 3).

Typical values for the die pressures (P) range between 200 and 1000 p.s.i. However, the actual back pressures can be considerably above those values in operations where screen packs are used. Accurate determinations of stock pressure may be made by using stock pressure gages (5,6).

Figure 4 shows a plot of extrusion viscosities versus temperature for several plastic melts.

The most useful conversion factors are summarized in Table I, and a

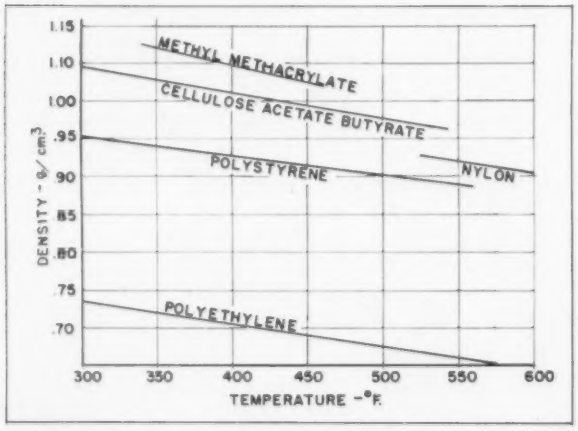


Fig. 3—Graph showing melt densities of several plastics materials over a range of temperatures. The Simplified Extruder Flow Equation gives output figures in volumetric units. The above plot aids in converting these figures to gravimetric terms, which are more generally used

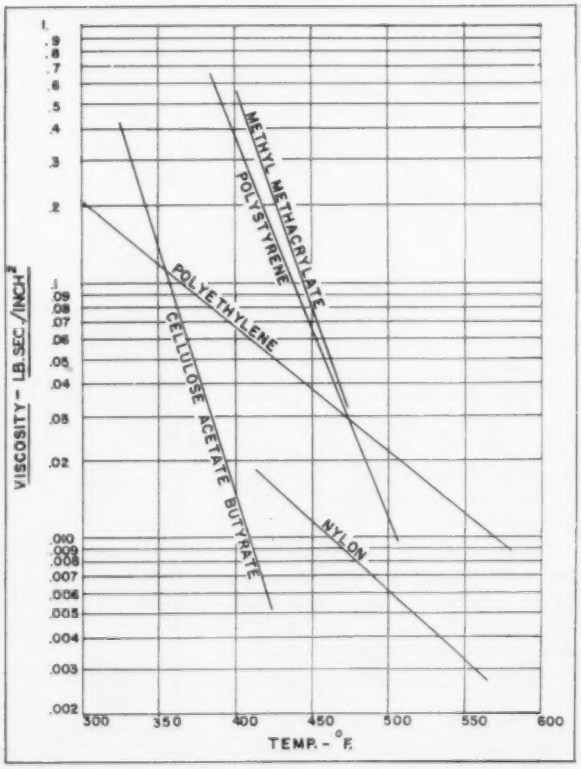


Fig. 4—Plot of extrusion viscosities (lb. sec./in.²) for the melts of several plastics materials over a range of temperatures

Table I—Conversion Factors

Helix Angle

The helix angle (φ) is related to the lead (t) and the diameter (D) of the screw, as shown in the formula:

$$t = \pi \, D \tan \varphi$$

If lead = diameter, then

$$\varphi = 17.8°, \text{ and}$$
$$\sin 17.8° = 0.306$$
$$\cos 17.8° = 0.952$$

Viscosities

10^1 poises = 0.145 lb. sec./in.^{2}

Some approximate extrusion viscosities are given in Fig. 4, p. 126.

Densities

To convert the volumetric output figures obtained from the Simplified Extruder Flow Equation into gravimetric units, the densities of polymer melts shown in Fig. 3, p. 126, are needed.

sample calculation showing how to use the Simplified Extruder Flow Equation is given in Table II.

It is important to recall under what assumptions these equations were originally derived and where they hold true:

1) The formulas were derived on the basis of laminar and Newtonian flow.

2) The formulas were derived assuming isothermal extrusion, i.e., no changes in temperature, viscosity, or density over the length of the metering section.

3) The equations hold true only for shallow screw channels where the ratio of channel width to channel depth is 10 to 1 or greater.

4) The formulas for drag flow and pressure flow are simplified formulas, and ignore the space taken up by the land. Neglecting the land will lead us to calculate output figures which are slightly too high.

5) The formula $Q = Q_D - Q_P$ ignores the leakage which takes place over the top of the lands, between the land and the cylinder wall. In general practice, the Simplified Extruder Equation makes it possible to calculate the extruder performance to an accuracy of about $\pm 15\%$ for ordinary extruder operations.

Performance Characteristics

The principal flow patterns which occur in the metering section of an extruder screw have now been analyzed. Also, a simple formula is available for giving numerical values to these flows. The next step is to see what type of characteristics might be expected from different types of screws.

Figure 5, p. 229, shows pressure-discharge characteristics of three screws with different metering sections, operating at same speed.

A screw with a deep metering section would have an output-versus-pressure diagram like the one shown in Curve 1, Fig. 5. The output of such a screw at low back pressures would be very high because the deep channel causes a very high drag-flow capacity. Also, such a screw is very susceptible to back pressure, since the large channel constitutes a very large orifice through which pressure flow can take place.

Curve 2 shows the discharge characteristics of the same deep-channel screw as in Curve 1 but with a longer metering section. We see that the drag flow at zero pressure of "open discharge" is still the same but the effect of back pressure is reduced through the additional channel length in the metering section.

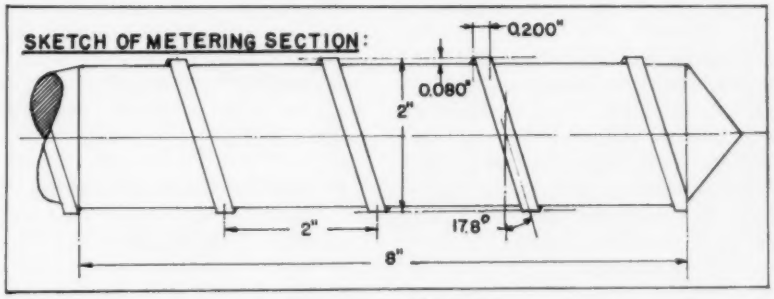
If the screw (Curve 3) had a shallow metering section (as commonly used in nylon extrusion), the output at zero back pressure (open discharge) would be somewhat lower because the drag flow capacity of a screw is in proportion to the channel depth; but at the same time the screw would be much less sensitive to back pressure, because the shallow channel provides a very much greater restriction to pressure flow.

Interpretation of Results

The advantage of being able to make a simple calculation of the expected extruder output is that operating difficulties can be traced to a specific zone of the extruder. The extruder consists essentially of a melting device (feed and compres-

(*To page* 229)

Table II—Sample Calculation



Operating conditions:

Screw speed:	90 r.p.m.	Stock temperature die:	435° F.
Material:	Polyethylene	Stock viscosity:	0.045 lb. sec./in.^{2}
Die pressure:	600 p.s.i.		

Values for terms in the flow equation:

$D = 2$ in.	$N = 1.5$ r.p.s.	$\cos \varphi = 0.952$
$h = 0.080$ in.	$\varphi = 17.8°$	$\mu = 0.045$ lb. sec./in.^{2}
$L = 8$ in.	$\sin \varphi = 0.306$	$P = 600$ p.s.i.

Calculation:

$$Q = \frac{(\pi)^2 \, (2)^2 \, (1.5) \, (0.080) \, (0.306) \, (0.952)}{2} - \frac{(\pi) \, (2) \, (0.080)^3 \, (0.306)^2 \, (600)}{(12) \, (0.045) \, (8)}$$

$$Q = 0.69 - 0.04$$
$$Q = 0.65 \text{ in.}^3/\text{sec.}$$

Density of polyethylene at 435° F. is approximately 0.74 g./cm.^{3}

$$\left(\frac{0.65 \text{ in.}^3}{\text{sec.}}\right)\left(\frac{16.4 \text{ cm.}^3}{\text{in.}^3}\right)\left(\frac{0.74 \text{ g.}}{\text{cm.}^3}\right)\left(\frac{3600 \text{ sec.}}{\text{hr.}}\right)\left(\frac{1 \text{ lb.}}{454 \text{ g.}}\right) = 62.5 \text{ lb./hr.}$$

Conclusions:

1) Screw should put out 62.5 lb./hr. at 90 r.p.m.

2) Operation should be relatively insensitive to back pressure. Back flow was only 0.04 in.^{3}/sec. in output of 0.65 in.^{3}/sec. or only about 6%. Therefore the die restriction should have little influence on output.

S.P.E. Technical Conference

THEME of the 11th Annual Technical Conference of The Society of Plastics Engineers, January 19-21, 1955, Haddon Hall Hotel, Atlantic City, N. J., is "Growth—Through Engineering." A registration of over 2000 is expected — highest in history. Some 60 papers will be presented, making it necessary to have three simultaneous sessions during the three conference days.

Following are the available abstracts of papers to be given at this conference:

FLUOROCARBON PANEL

George Koch, B. F. Goodrich Chemical Co., Moderator.

Properties and Characteristics of Kel-F. *Jules A. Jupa, M. W. Kellogg Co.,* will review the physical properties of Kel-F and then discuss the importance of crystallization, dispersions, fillers, Kel-F inks, and Kel-F laminates. Hot-runner molding of Kel-F will also be described.

Molding and Fabrication of Polymonochlorotrifluoroethylene. *William C. Campbell, U. S. Gasket Co.,* will discuss injection molding, extruding, compression molding, and transfer molding, giving consideration to equipment, design factors, molding practices, and cost. Fabricating techniques of machining, grinding, drilling and tapping, and cementing and welding will also be covered.

Fluorolubes, Lower Molecular Weight Polymers of Chlorotrifluoroethylene. *L. S. Bovier, Hooker Electrochemical Co.,* will give the typical properties, liquid densities, liquid pressure, and characteristics of Fluorolube oils and greases. The effects of Fluorolubes on the properties of various plastics at room temperature and elevated temperatures will be shown. Information on the application of Fluorolube will be included.

Molding of Teflon. *C. M. Hobson, U. S. Gasket Co.,* will begin with the basic principle of converting T.F.E. powder into homogeneous solid form. He will then describe the general types of converted material available such as sheet, powder and paste extruded parts, cylinders, and molded parts. The major problems encountered in the conversion of T.F.E. such as contamination, mold materials, moisture, etc., will also be discussed. Mr. Hobson will bring the talk to a conclusion by showing how the fabrication of T.F.E. is analogous to sintered metallurgy and how the properties of T.F.E. can be altered by technique and fillers.

Physical Properties of Teflon Tetrafluoroethylene Resin. *R. C. Doban, B. W. Sandt, and C. A. Sperati, E. I. du Pont de Nemours & Co., Inc.,* will describe the properties of Teflon and will explain them in relation to the chemical structure of the material.

POLYETHYLENE PANEL

Ed Childs, Monsanto Chemical Co., Moderator.

Polyethylene's Future. *Mr. Childs* will begin the panel discussion by reviewing the growth and present potentials of polyethylene in the fields of pipe, film, wire, bottles, laminates, and molded parts.

Progress in Materials. *J. E. Brister, Bakelite Co.,* will stress the properties of polyethylene that relate to its successful use in wire, pipe, film, bottles, and miscellaneous moldings. Some mention will be made of modifications of polyethylene for specific uses. Economics of the materials will be touched on briefly.

What Makes the Sale. *C. A. Harper, Sears, Roebuck & Co.,* will explain why polyethylene, compared with other plastics, enjoys such a wide consumer acceptance. He will then outline the opportunities for further sales expansion in terms of specific items, material, and design improvements.

CONTROLS PANEL

Paul A. West, Sterling, Inc., Moderator.

General Principles of Mold Temperature Control. *Mr. West* will discuss the methods of producing correct and uniform mold surface temperatures by means of a heat transfer fluid. Some of the fundamental considerations of design and operation of equipment for delivering heat transfer fluid at a constant and controlled temperature to the mold will also be covered.

Temperature Control With Mold Design. *C. H. Whitlock, C. H. Whitlock Assoc.,* will deal with the problem of designing the mold to obtain the ultimate in temperature control for the most satisfactory results in any plastics forming operation. With slides, Mr. Whitlock will show case histories of improper channeling in injection molds and the corrective measures taken.

TOOLING FOR REINFORCED PLASTICS PANEL

H. S. Nathan, Atlas Plastics, Moderator.

Factors Affecting Production Tooling for Reinforced Plastics. *Messrs. S. Fingerhut, P. Levy, J. Marzicola, O. Silverwood, and G. Stamos, Zenith Plastics Co.,* will show how much tooling is necessary for the product and how to meet the standards of close tool tolerance necessary to insure high production.

HEATING CYLINDERS PANEL

E. W. Cronin, Hercules Powder Co., Moderator.

Injection Molding Machine Heating Cylinder Design. *C. E. Beyer, R. B. Dahl, and R. B. McKee, The Dow Chemical Co.,* will present a series of three papers covering, 1) temperature and pressure measurements in the heating cylinder; 2) temperature variations in the heating cylinder; and 3) design of heating cylinders. Theoretical aspects, test methods and results, and practical application will be discussed.

OTHER PAPERS

Laminates for Printed Circuits

Norman Skow, Synthane Corp., will give a brief history of printed circuits and describe some of the problems encountered in developing a plastic laminate for printed circuitry. Methods of manufacture of foil-clad laminates, as well as the stamped-circuit, silk-screening,

photo-etching, and other methods of fabricating printed circuitry will be discussed.

Runnerless Molding

Ernest P. Moslo, Moslo Machinery Co., will elaborate on the tried and proven methods of runnerless molding such as direct injection from a nozzle into a single mold cavity, direct injection from multiple nozzles into two or more cavities, and hot or confined runners to multiple cavities. Design detail of the various methods in use today will be shown. Several methods that are being experimentally used at this time will be described.

Heat Bonding of Teflon Tetrafluoroethylene Resin.

P. J. Wayne and W. M. Bruner, Du Pont, will explain how the difficulties in bonding Teflon to itself are largely removed by a new method. This is accomplished by heat-bonding sections of Teflon at a temperature of about 375° C. with the aid of a flux-like material under a contact pressure of about 35 p.s.i. Heat-bonding of Teflon for use in various industrial fabricating operations such as the lining of vessels and fume ducts will be described.

Engineering of Mold Design

Wayne I. Pribble, Pribble Plastics Products, Inc., will cover the considerations that must be given the tool makers' and molders' problems from the viewpoint of the mold designer. A typical medium-size phenolic molding job (table model radio cabinet) will be carried through the following stages: how a good parts drawing helps the mold designer, basic data required from molder, initial mold layout, development of assembly drawings, and importance of detail drawings. This "How-To-Do-It" paper will be well illustrated by slides and other visual aids.

Welding and Flame Spraying of Plastics

J. A. Neumann, American Agile Corp., will describe welding and spraying guns, the methods of welding and spraying, and the plastics that are suitable for welding and spraying. Applications of welding and spraying in vessels, duct lines, and covered appliances will be discussed. The future of plastic materials as structures for industry will be outlined. This paper will be illustrated by 30 colored slides.

Dry-Blend Compounding of Polyvinyl Chloride Resins

O. L. Law and W. Q. Gordon, Goodyear Tire & Rubber Co., will deal with dry-blending of polyvinyl chloride — the technique of compounding resins, plasticizers, stabilizers, colors, fillers, and lubricants in the form of a dry, free-flowing powder. Characteristics of the resin and the dispersions will also be discussed, emphasizing the nature of the resin particle as the determining factor in the development of a good dry blend compound. Equipment suitable for dry blend operations will be reviewed.

New Applications of Old Materials

R. E. Brannan, Bakelite Co., will cover some of the past experience in developing uses for phenolic resins such as iron handles, radio and TV cabinets, and washing machine agitators. Finding new applications in the oil industry (Microballoons) and the furniture field will then be discussed.

Plastics in the Atomic Energy Program

Oscar Sisman, Oak Ridge Lab., will give an account of life among the hot plastics. The use of high energy radiation to induce changes in plastics, the mechanism of radiation effects, and the physical properties of irradiated plastics will be described.

Compounding and Processing Copolymer Styrene Resins for the Manufacture of Tough, Rigid Plastics

R. J. McCutcheon and K. K. Fligor, Goodyear Tire and Rubber Co., will describe those properties of Plio-tuf which help bridge the existing gaps between plastics, rubber, and metals. The blending of Plio-tuf with other materials and the molding of these resins will also be discussed.

Mold Parts of Hard Electroformed Nickel for Molds for Plastics

W. J. B. Stokes II, Stokes-Trenton, Inc., will describe the method of manufacture and the properties of electroformed cavity parts. The unusual mold construction details permitted by using the electroforming process and the limitations of electroformed cavity parts will also be discussed.

Mycalex

H. M. Patterson, General Electric Co., will present technical data obtained in the development of new G-E mycalex grades. Significant new applications and technical aspects of the design problems involved will be emphasized.

New Silicone Rubbers

G. S. Irby, General Electric Co., will describe the recent developments in silicone rubber, especially G-E's new Super Tough grade with its greater tear strength and better oil resistance. Case histories will show the use of silicone parts to solve difficult engineering problems.

Modern Applications for Modified Styrene Sheet

Robert F. Hrudka, Chicago Molded Products Corp., will describe the new combinations of materials and fabricating techniques that are greatly extending the use of modified styrene sheet. New materials include those with a brilliant finish and those with increased impact strength. Improved techniques include a combination of stretch forming and vacuum forming, controlled area or pattern heating, and new types of inserts to provide reinforcement and/or complex shapes. Detailed case histories will be given.

Color, Paint, and Plastic

Lloyd E. Parks, Logo, Inc., will give a detailed account of the use of paint on plastics. The development of a paint formulation as a coating for plastics will be discussed as well as the methods of spraying, silk screening, printing, etc., and such problems as adhesion, humidity blush, pinholing, etc.

Applications of Silicone Rubber

S. K. Moxness, Moxness Tool Works, will give a short resume of present and probable future applications of silicone rubber in molded or extruded shapes in the aircraft, electrical, and other industries.

Vacuum Forming

E. B. Stratton, Auto-Vac Co., will discuss the various methods of vac-

(*To page* 230)

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PLASTICS*
TECHNICAL SECTION: Dr. Gordon M. Kline, Technical Editor

Stabilization of Polyesters to Light

by RUSSELL T. DEAN† and JOSEPH P. MANASIA†

INCREASED use of translucent polyester-fibrous glass panels as decorative and structural materials for skylights, awnings, porch roofs, partitions, etc., has obliged manufacturers in the last several years to emphasize the development of polyester compositions that are resistant to yellowing on exposure to ultra-violet light. A technology of stabilizers has been evolved and now the destructive action of ultra-violet radiation is of consequence only under conditions of prolonged and severe exposures.

Ultra-violet light, with which we are primarily concerned in polyester degradation, is one kind of radiant energy of the electromagnetic spectrum. Other well known forms of the solar spectrum present at the earth's surface are visible and infra-red light. Light is most commonly characterized in terms of its wavelength. The region between 400 and 800 millimicrons is visible to the human eye and produces the sensation of color. This range is called the visible spectrum. The region below 400 millimicrons is designated as ultra-violet light and that above 800 millimicrons as infra-red light. Sunlight contains 3 to 5% ultra-violet radiation.

The chemical changes associated with the yellowing of cured polyesters on prolonged exposure to light are in all likelihood initiated photochemically. That is to say, the chemical reactions that form colored compounds are started in some way by the absorbed light energy. The ultra-violet region of the solar spectrum is thought to be particularly active in this respect. Tests described later in this article show that light of wavelengths below 390 millimicrons is very destructive while above this value it is almost inactive.

Freshly prepared cast sheets of polyesters strongly absorb light of wavelengths below about 350 millimicrons. This is the region where the degradative action of light is pronounced; therefore, the problem of stabilization is essentially the problem of dissipating the absorbed energy in some manner not associated with the development of color.

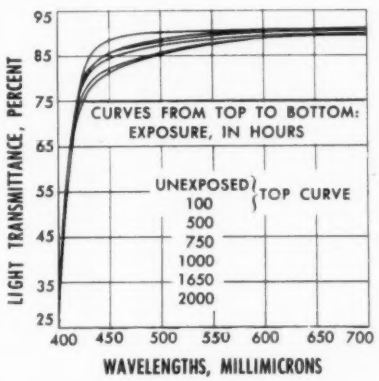

Fig. 1—Fadeometer exposures of IC 312-2

An interesting demonstration of the action of light on clear polyesters was noticed in the course of this work. A panel of IC 312 polyester, 0.25 in. thick, was exposed in the Fadeometer and samples about 0.25 in. wide were cut off at several time intervals and polished on the edges. Examination showed that as the exposure time increased, color accumulated near the surface exposed to the light source. This concentration of color can be explained on the basis that more light is absorbed by the side of the sample facing the light source and as a consequence color

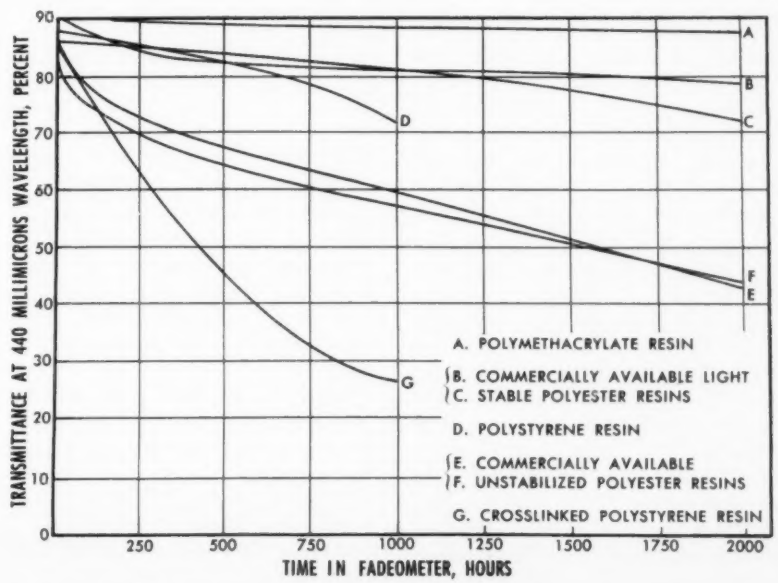

Fig. 2—Yellowing of 1/8 in. thick polyester, acrylic, and styrene plastics in Fadeometer

* Reg. U. S. Pat. Off.
† Research Laboratories, Interchemical Corp.

Table I—Effect of Additives on the Light Stability of IC 312 Polyester

Additive	Amount added	Light transmission at 440 mμ		Barcol hardness
		Original	After 1000 hr.	
	%	%	%	
Control	—	87[a]	61	53
Control	—	87	70 (500 hr.)	53
Acetylsalicylic acid	1.0	88	64	53
Acetylsalicylic acid	5.0	88	54	52
Phenyl salicylate	0.1	88	67	52
Phenyl salicylate	0.5	88	51	53
Phenyl salicylate	1.0	88	78	52
Phenyl salicylate	5.0	88	80	50
2-Hydroxybenzophenone derivative A	0.1	87	77	51
2-Hydroxybenzophenone derivative A	0.2	87	76	52
2-Hydroxybenzophenone derivative A	0.5	87	80	54
2-Hydroxybenzophenone derivative B	0.1	87	75	52
2-Hydroxybenzophenone derivative B	0.2	89	80	54
2-Hydroxybenzophenone derivative B	0.3	89	83	55
Phenyl alpha-resorcylate	1.0	87	71 (750 hr.)	53
Resorcinol monobenzoate	1.0	88	74 (500 hr.)	54
4,4′-Dihydroxybenzophenone	0.1	87	57 (150 hr.)	54
4,4′-Dihydroxybenzophenone	0.5	86	20 (150 hr.)	54
Phenyl phthalate	1.0	87	70 (500 hr.)	55
Benzoyl benzoic acid	1.0	87	36 (150 hr.)	54
Salicylaldehyde	0.1	88	72 (500 hr.)	53
Salicylaldehyde	1.0	88	72 (500 hr.)	53

[a] 92% for perfect transparency.

develops at a faster rate in this region. In addition, when color is developed the ability to absorb light increases, with the result that the rate of yellowing near the exposed surface becomes increasingly greater than on the opposite side.

Considerable effort was expended in attempting to improve the light stability of IC 312 polyester by purifying the raw materials, changing the formulations, and modifying the method of preparation. With extreme care, improvements in initial color were achieved, but the resins still yellowed at a faster rate than the stabilized IC 312-2 polyester. It was concluded that IC 312 polyester was as stable a resin as could be obtained by commercial manufacturing methods without employing additives. Apparently, conventional polyester resins contain some labile groupings that have a tendency to develop color on exposure.

Preparation of Cast Sheets

An initial problem in studying the action of stabilizers was the development of reliable test methods for estimating the resistance of cured sheets to prolonged exposure. A technique was worked out for the preparation and evaluation of cast clear panels.

Suitable molds were made from two sheets of plate glass 12 by 12 by 0.25 in., which were thoroughly cleaned with glass wax. A separating gasket was prepared by wrapping about 42 in. of Tygon tubing R8410 (inner diameter 0.120 in., wall thickness 0.025 in.) with a 0.75 in. wide cellophane tape (PT 450). A stiff wire was inserted into the tubing prior to wrapping to give rigidity. The gasket was then bent to a rectangle about 9 in. square with an opening at the top and the mold was assembled with the aid of 11 C clamps. The clamps were carefully adjusted to give a uniform mold thickness of 0.125 inch. With care at this point it was possible to obtain finished sheets 0.090 to 0.100 in. thick, with variations in thickness within each sheet of only 1 or 2 mils.

Resins were catalyzed, except as noted, with 2% benzoyl peroxide paste (50% benzoyl peroxide dispersed in tricresyl phosphate) and de-aerated under vacuum. The molds were filled through the opening in the gasket at the top leaving about 1.5 in. of air space. Curing was effected in two steps: immersion in a water bath at 70° C. for 3 hr., followed by heating in an air oven at 105° C. for 2 hours. For best results the gaskets were removed and the plates separated from the cast sheets while still warm. The Barcol hardness of the sheets was measured after 24 hr. at room temperature; a reading of 50 units or higher indicated a good cure. Samples of suitable size were cut from the finished sheets with a band saw.

Obviously, this curing schedule does not correspond to any process used commercially. It was selected as a convenient means of preparing samples for exposure studies. No attempt was made to estimate the actual temperature of the resin during the heating cycle. The large mass of the glass in the molds as compared with the resin undoubtedly moderated the rate of heating, particularly in the air oven.

One question that can be raised is the effect of degree of cure on stability against ultra-violet radiation. Carefully controlled tests have shown that undercured panels, as indicated by a low Barcol hardness (below 50 for IC 312 polyester), discolored at a much greater rate than those with higher values. Prolonged cure at 105° C. to a hardness of 56 gave slightly additional stability without any sacrifice in original color. By way of comparison it should be noted that the Barcol hardness of IC 312 polyester is usually about 53 when the curing schedule outlined above is used. Curing temperatures above 105° C. were not investigated systemati-

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IN PANELS

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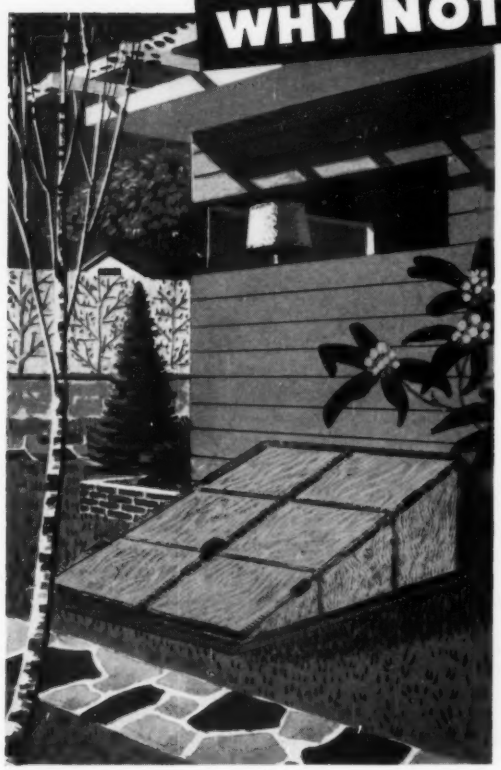
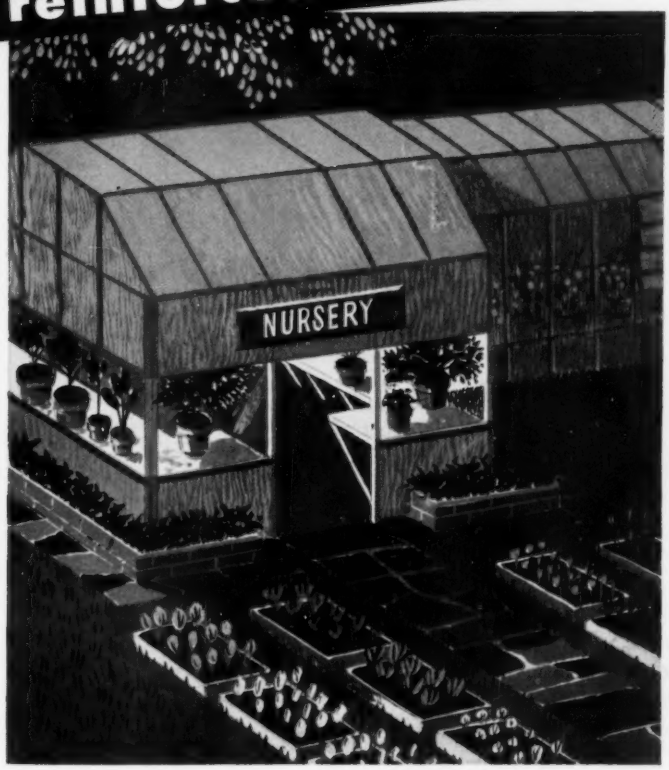


...BASEMENT HATCHWAYS



...GREENHOUSES

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cally, but extreme cases of long cure at high temperatures produced off-colored panels that exhibited yellowing at an excessive rate on being exposed.

Exposure Tests

Exposure tests were run initially in both an Atlas Color Fadeometer FDA-R and an Atlas Twin-Arc Weatherometer DLTS. The yellowing tendencies of samples exposed in different spots of each instrument were found to check very closely, indicating good light distribution. Whether exposure was intermittent or continuous had little effect on the final color of the panels. Panels in the Fadeometer showed a measurably faster rate of color deterioration than those in the Weatherometer. The Fadeometer was accordingly selected for use and all data reported in this article were obtained with it. Exposures were carried out in the usual manner for this instrument and samples removed for examination at convenient intervals.

The color of the panels before and at various stages of exposure was measured by the G. E. spectrophotometer. Before measurement, the panels were carefully washed with an aqueous detergent (Glim) solution, rinsed with distilled water, and dried. A family of transmission curves was obtained for each resin showing the precise nature of the color as it changed with time. An examination of these data indicated that the color changes could be conveniently expressed in terms of the change in transmission at the wavelength of 440 millimicrons.

Figure 1, p. 131, for IC 312-2 polyester cured with 1% methyl ethyl ketone peroxide illustrates the type of curves obtained with the G. E. spectrophotometer. Figure 2, p. 131, shows the data for a number of commercially available materials on plotting transmission at 440 millimicrons versus time. The sheets of polymethyl methacrylate, polystyrene, and cross-linked polystyrene included for reference were commercial products of 0.125 in. thickness. In examining these graphs it should be remembered that a perfectly transparent sheet of polyester gives a transmission value of 92%; the difference from 100% is lost by reflection at the front and back surfaces. The much greater rate of yellowing during the first 100 hr. of exposure was characteristic of all polyester sheets examined. After this period the rate became essentially linear with time up to about 1000 hours. Increased rates of yellowing after 1000 hr. were noted in some instances.

The superiority of light-stable polyesters over conventional unstabilized polyesters can be seen by

Table II—Effect of Catalysts on the Light Stability of IC 312 Polyester

Catalyst	Curing schedule	Light transmission at 440 mμ		Barcol hardness
		Original	After 1000 hr.	
		%	%	
1% benzoyl peroxide (solid)	3 hr. at 70° C. 2 hr. at 105° C.	89	71	53
2% benzoyl peroxide paste[a]	3 hr. at 70° C. 2 hr. at 105° C.	88	61	53
1% *tert*-butyl hydroperoxide	In oven at 115° C. for 5½ hr.	88	67	56
1% Di-*tert*-butyl peroxide	In oven at 115° C. for 5½ hr.	90	63	56
1% methyl ethyl ketone peroxide	3 hr. at 70° 2 hr. at 105° C.	88	50[b]	48[b]
1% dicumyl peroxide	2 hr. at 70° C. 3 hr. at 105° C.	88	62	55
1% diisopropylbenzene hydroperoxide	2 hr. at 105° C. 2 hr. at 130° C.	88	50	56
1% *p*-methane hydroperoxide	4 hr. at 130° C.	88	70	54

[a] 50% benzoyl peroxide dispersed in tricresyl phosphate
[b] This value is low because the panel is undercured.

Table III—Effect of Catalysts on the Light Stability of IC 312-2 Polyester

Catalyst	Curing schedule	Light transmission at 440 mμ			Barcol hardness
		Original	After 1000 hr.	After 2000 hr.	
		%	%	%	
1% benzoyl peroxide (solid)	3 hr. at 70° C. 2 hr. at 105° C.	89	83	79	53
2% benzoyl peroxide paste[a]	3 hr. at 70° C. 2 hr. at 105° C.	87	80	70	52
1% methyl ethyl ketone peroxide	3 hr. at 70° C. 2 hr. at 105° C.	90	83	80	53
1% *tert*-butyl hydroperoxide	115° C. for 5½ hr. (oven)	90	84	81	53
1% cumene hydroperoxide	130° C. for 4 hr. (oven)	88	82	78	54
1% *tert*-butyl perbenzoate	3 hr. at 70° C. 2 hr. at 120° C.	89	81	75	55
3% of a 50% solution of 2,4-dichlorobenzoyl peroxide in dibutyl phthalate	1½ hr. at 70° C. 3¼ hr. at 105° C.	89	73	—	49

[a] 50% benzoyl peroxide dispersed in tricresyl phosphate.

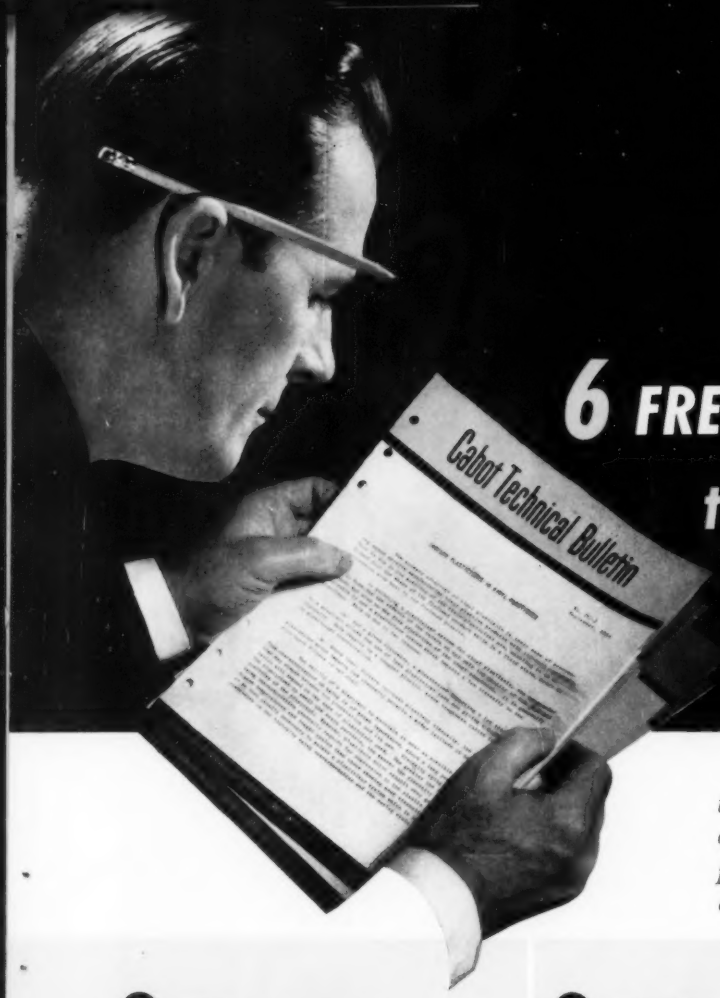

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Table IV—Effect of Catalyst-Activator Combinations on the Light Stability of IC 312-2 Polyester

Catalyst	Activator	Light transmission at 440 mμ		Barcol hardness
		Original	After 500 hr.	
		%	%	
0.5% methyl ethyl ketone peroxide	0.07% cobalt naphthenate[b]	86	85	54
1.0% methyl ethyl ketone peroxide	0.07% cobalt naphthenate[b]	86	84	53
2.0% methyl ethyl ketone peroxide	0.07% cobalt naphthenate[b]	86	82	52
1.0% methyl ethyl ketone peroxide	0.01% cobalt naphthenate[b]	88	86	52
1.0% methyl ethyl ketone peroxide	0.5% cobalt naphthenate[b]	81	79	52
1.0% methyl ethyl ketone peroxide	0.01% cobalt octoate[b]	86	84	52
1.0% methyl ethyl ketone peroxide	0.07% cobalt octoate[b]	88	85	53
0.5% methyl ethyl ketone peroxide, 0.5% benzoyl peroxide paste[a]	0.01% cobalt naphthenate[b]	87	86	52
0.5% methyl ethyl ketone peroxide, 0.5% benzoyl peroxide paste[a]	0.07% cobalt naphthenate[b]	86	85	52
1% cumene hydroperoxide	0.01% cobalt naphthenate[b]	87	84	54
1% cumene hydroperoxide	0.07% cobalt naphthenate[b]	85	82	53
1% benzoyl peroxide paste[a]	0.05% lauryl mercaptan	88	86	55
0.5% cumene hydroperoxide	0.05% lauryl mercaptan	89	85	55
1% methyl ethyl ketone peroxide	0.05 lauryl mercaptan	87	85	55
2% benzoyl peroxide paste[a]	Control	87	83	52

[a] 50% benzoyl peroxide dispersed in tricresyl phosphate.
[b] Percentage of a 6% solution of cobalt naphthenate or cobalt octoate, respectively.

comparing curves B and C with E and F in Fig. 2. Polymethyl methacrylate showed little yellowing even at 2000 hr., while polystyrene, although fairly good at first, began to yellow at an excessive rate at about 750 hours. Surprisingly, cross-linked polystyrene darkened very rapidly right from the start of the experiment.

Preliminary experiments with glass-filled laminates of IC 312 polyester indicated that the glass fibers had little if any effect on stability towards light.

Attempts were made to follow the chemical changes related to the deterioration in color of cured polyester resins by studies of the infra-red absorption. After 1000 hr. of exposure in the Fadeometer no changes were picked up by the techniques normally applied with a conventional instrument using a sodium chloride prism. A new technique was developed for preparing continuous cast sheets of cured polyester resins thin enough for measurement of the infra-red absorption characteristics. For example, IC 312 polyester was diluted with styrene to 65% resin solids and then catalyzed with 1% benzoyl peroxide. A few drops of this solution was sandwiched between two clean lantern slide glasses, which were then pressed tightly together with the fingers to spread the resin over a large area. Capillary attraction held the plates together. They were then placed in an oven and the resin cured at 105° C. for 2½ hours. Films ranging from 0.2 to 0.4 mil in thickness were obtained in this manner.

Stabilizers

The stabilization of cured polyesters with additives requires a careful selection of materials. A suitable stabilizer must meet a number of conditions: 1) high absorption capacity for the ultra-violet region of the solar spectrum from 290 to 390 millimicrons; 2) ability to dissipate absorbed energy in a manner that neither physically damages the polyester nor produces color; 3) stability against self-destruction by absorbed energy; 4) compatibility with the polyester, both uncured and cured; 5) water insolubility; and 6) freedom from odor as well as color.

The ability of organic compounds to absorb light has been the subject of a large number of studies. Reasonably accurate prediction can now be made of the light-absorptive ability of various materials if the nature of their chemical structure is a known factor.

The selective absorption of light by organic compounds is known to be related to the type and degree of unsaturation present. Some form of light is absorbed by all materials comprised of molecules that contain double or triple bonds. Singly unsaturated hydrocarbons absorb only wavelengths below 200 millimicrons, but if they are conjugated with another unsaturated group, enhanced absorption in the region of longer wavelengths may be expected. With increasing conjugation, shifts to still longer wavelengths and greater intensities are produced. There are numerous examples of highly unsaturated hydrocarbons that are

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Table V—Effect of Metals on Light Stability of IC 312 Polyester

Metal added	Concentration	Curing schedule	Light transmission at 440 mμ: Original	Light transmission at 440 mμ: After 1000 hr.	Barcol hardness
	%		%	%	
Sn	0.01	3 hr. at 70° C. 2 hr. at 105° C.	88	68	50
Fe	0.01	3 hr. at 70° C. 3 hr. at 105° C.	72	34	48
Co	0.01	3 hr. at 70° C. 2 hr. at 105° C.	86	42.5	49
Mn	0.01	3 hr. at 70° C. 2 hr. at 105° C.	86	45	48
Control	—	3 hr. at 70° C. 2 hr. at 105° C.	87	61	53

known to absorb light in the visible spectrum.

Compounds containing single benzene rings absorb in the region below 350 millimicrons. The aromatic nuclei of the phthalic esters and styrene groups in cured polyesters are largely responsible for the ultra-violet absorption properties of these single-benzene-ring containing products.

Light is weakly absorbed at wavelengths longer than 200 millimicrons by groups such as -C=O, -N=O, $-NO^2$, -N = N-, and -C = S, which are called chromophores. When the chromophores are present in the same aromatic rings with the salt-forming groups $-NH_2$, -OH, $-SO_3H$, and -COOH, known as auxochromes, there is a remarkably great enhancement of the absorptive capacity of the compound with a shift to longer wavelengths.

These effects, presented here in a greatly oversimplified form, are useful in understanding why dyestuffs are strongly absorptive in the visible spectrum. They also apply in the case of materials that are powerful ultra-violet light absorbers with almost no activity in the visible region. Materials of this type are acetylsalicylic acid, phenyl salicylate, and the ortho-hydroxybenzophenone derivatives. Here the chromophoric group is the -C=O and the auxochromes are the -OH and possibly other substituent groups.

The stabilizing action of these materials and a number of somewhat similar compounds on IC 312 polyester is shown in Table I, p. 132. The test panels for this series of stabilization tests were prepared as described above.

Of the materials tested, the ortho-hydroxybenzophenone derivatives *A* and *B* were the most effective. Phenyl salicylate was also a good stabilizer; however, it was somewhat less active.

A number of the compounds tested, phenyl alpha-resorcylate, resorcinol monobenzoate, and salicylaldehyde, although relatively good absorbers in the ultra-violet region, were not effective stabilizers. It is thought that they were self-destructive on absorbing energy and were changed into harmless inactive materials. However, 4,4′-dihydroxybenzophenone appeared to be a strong absorber that utilized the absorbed energy to initiate degradative chemical reaction leading as a result to substances that are highly colored.

Catalysts and Activators

Important to the users of polyester resins is the effect of the various catalyst and catalyst-activator systems on the light stability of the finished sheets. Two studies with catalysts were made: one with a conventional polyester, IC 312 polyester, and the other with a light-stable material, IC 312-2 polyester. The results of these studies are presented in Tables II, p. 134, and III, p. 134, respectively.

Best results with both resins were obtained with solid benzoyl peroxide and *tert*-butyl hydroperoxide. The poorer stability of the panels with benzoyl peroxide paste (50% benzoyl peroxide in tricresyl phosphate) as compared with those containing solid benzoyl peroxide was attributed to an adverse action of the tricresyl phosphate. With IC 312-2 polyester, methyl ethyl ketone peroxide gave a well-cured panel of good stability, but with IC 312 polyester, for an unexplained reason, the cure was poor and the stability accordingly inferior.

Table IV, p. 136, lists the data for the catalyst-activator systems. All these panels were cured in the same manner: 3 hr. at 70° C. in a water bath, followed by 2 hr. at 105° C. in an oven.

No adverse effect on the light stability at the end of 500 hr. resulted

(*To page* 233)

Table VI—Wavelength of Light versus Stability of IC 312 Polyester

Filter No.	All light cut off below wavelength	Light transmission at 440 mμ after 1000 hr. exposure[a]
	mμ	%
1	300	56
2	330	68
3	390	86
4	420	88
5	475	88
6	585	87
7	620	88
8	920	87

[a] Unexposed panel had 87.5% light transmission

Mixed Plasticizers in Vinyl Chloride Resins

by L. H. WARTMAN*

A method is given for predicting certain properties of plasticized vinyl chloride resin compounds which contain more than one plasticizer. The method is shown experimentally to be applicable to brittle temperature, SPI volatility, plasticizer rub-off and nitrocellulose marring. These properties of the mixed plasticizer compound are related in a simple manner to the concentrations of the individual plasticizers and to the values of each of these same properties in compounds containing the individual plasticizers.

IN ORDER to obtain the most suitable combination of properties in plasticized vinyl compounds, it is often advantageous to formulate with two or more plasticizers. For example, low-temperature plasticizers are often used along with resinous types to obtain a compromise between cold flex and permanence properties. In recent years there has been an increasing tendency in this direction. The ever-present demand for high quality at a reasonable price has necessitated the use of combinations of two or even three plasticizers.

With the great number of plasticizers now commercially available, it is a difficult problem to select suitable combinations for any specific application. Commercial suppliers of plasticizers generally provide property data on their materials in typical vinyl chloride polymer formulations. Naturally, it would be desirable to devise a system whereby these data on compounds of single plasticizers could be used to predict the properties that would be obtained on compounds containing more than one plasticizer. The work reported herein had this as its object.

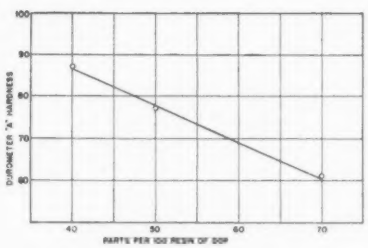

Fig. 1—Effect of Flexol DOP concentration on durometer "A" hardness

Background

Very few data have been published in the literature comparing the properties of mixed plasticizer compounds to the properties of compounds of the individual plasticizers. Hayes and Lannon (2,3)[1] have investigated stiffness as measured by the Clash and Berg (1) technique on plasticized compositions containing mixtures of TTP (tri-tolyl phosphate)[2] and DOS (di-octyl sebacate). They report that the cold flex temperature (temperature at which the compound has a modulus of rigidity of 23,000 p.s.i.) decreases linearly with increasing weight fraction of DOS in the mixture. Williamson (10) studied the same formulations using a slightly different method of measuring stiffness. His results show a slight curvature when plotted in the same fashion. He ascribes the difference between his results and those of Hayes and Lannon to the error inherent in calculating a rigidity modulus from the data obtained in any torsional bending experiment. Quackenbos (4) has studied the diffusion-controlled extraction of plasticizers from vinyl films. On theoretical grounds he shows that the diffusion constant in a mixed plasticizer system can be calculated from the data on compounds of the individual plasticizers.

These results suggest that it may be possible to compute cold flex and extraction properties of mixed

* Development Laboratories, Bakelite Co., a Div. of Union Carbide and Carbon Corp.

[1] Numbers in parenthesis link to references at end of article, page 153.
[2] Suppliers and complete trademarks identifying the various plasticizers mentioned in the text can be found in Table I, below.

Table I—Plasticizers Used in This Investigation

Abbr.	Tradename	Supplier	Chemical Name or Description
DOP	Flexol plasticizer DOP	Carbide and Carbon Chemicals Co.	Di-2-ethylhexyl phthalate
TOF	Flexol plasticizer TOF	Carbide and Carbon Chemicals Co.	Tri-2-ethylhexyl phosphate
G-50	Paraplex plasticizer G-50	Rohm and Haas Co.	Semi-resinous
G-62	Paraplex plasticizer G-62	Rohm and Haas Co.	An epoxidized oil
9058	Plastolein plasticizer 9058	Emery Industries	Di-2-ethylhexyl azelate
4GO	Flexol plasticizer 4GO	Carbide and Carbon Chemicals Co.	Di-2-ethylhexoate of polyethylene glycol
R-2H	Flexol plasticizer R-2H	Carbide and Carbon Chemicals Co.	Resinous
HB-40	HB-40	Monsanto Chemical Co.	Partially hydrogenated mixture of isomeric terphenyls
TTP	.....	.....	Tritolyl phosphate
DOS	.....	.....	Dioctyl sebacate

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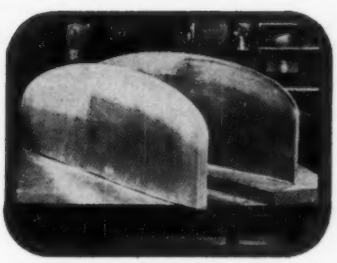
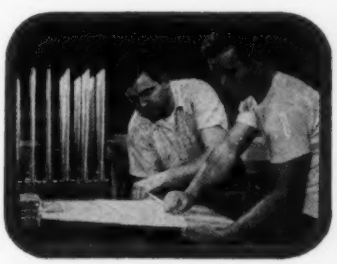


Lay-up molds of resin #76 are utilized to produce polyester-impregnated fibrous cloth wing tips by bag molding.



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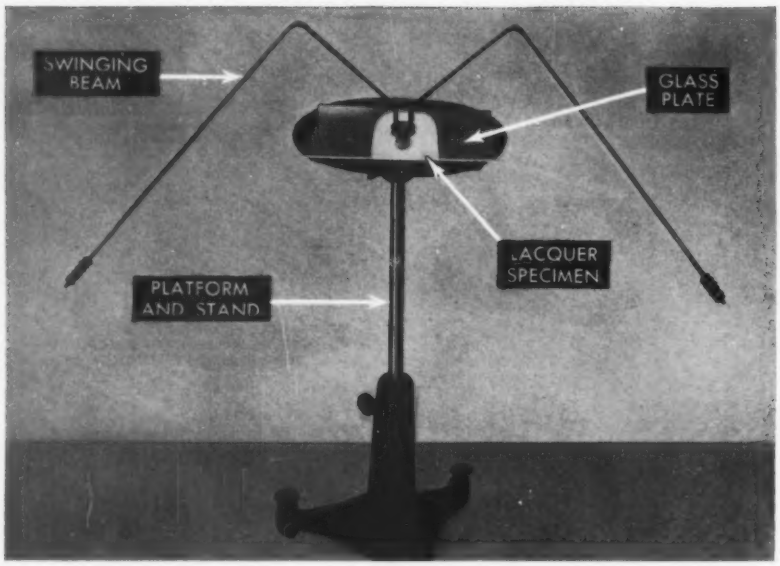

Fig. 2—Swinging-beam apparatus used to measure the hardness of vinyl film. This instrument is an adaptation of test equipment originally developed for testing varnish film

Table II—Properties of DOP-TOF Compounds

Composition[a] DOP	TOF	Durometer "A" Calc.	Found	Brittle Temp. Calc.	Found	SPI Volatility Calc.	Found	Rub-Off "K" Calc.	Found
p.h.r.	p.h.r.			°C.	°C.				
48	0	—	80	—	—22	—	3.6	—	1.0
36	11	81	78	—30	—32	4.6	4.4	1.8	2.0
24	22	82	80	—38	—38	5.6	5.1	2.6	2.5
12	33	82	81	—46	—48	6.7	6.2	3.4	3.7
0	44	—	83	—	—54	—	7.7	—	4.2

[a] P.h.r. is parts per 100 parts of Bakelite vinyl resin VYNW

Table III—Properties of Mixed Plasticizer Compounds DOP, G-50, 9058

% of Efficiency Concentration[a] DOP	G-50	9058	Durometer "A" Calc.	Found	Brittle Temp. Calc.	Found	SPI Volatility Calc.	Found	Rub-Off "K" Calc.	Found
					°C.	°C.				
100			—	82	—	—22	—	3.6	—	1.3
	100		—	84	—	— 9	—	.8	—	1.1
		100	—	86	—	—44	—	2.9	—	3.9
20	60	20	84	85	—19	—16	1.8	2.1	1.7	1.4
40	25	35	84	84	—26	—22	2.7	4.0	2.1	1.8
45	10	65	85	85	—35	—28	2.9	2.9	3.0	2.1
10	25	65	85	85	—33	—28	2.4	2.7	2.9	2.1
70	20	10	83	80	—22	—20	3.0	3.2	1.5	1.4

[a] Efficiency Concentration (Durometer "A" = 80)

DOP	=	47 p.h.r.
G-50	=	52 p.h.r.
9058	=	39 p.h.r.

(47 p.h.r. of DOP were used in this experiment. In other data (Tables II, IV, and V) 48 p.h.r. were used.)

plasticizer compounds if the data on the individual plasticizers are available. Whether other properties such as volatility and brittle temperature can also be handled this way remains to be seen. In order to determine if a simple system could be devised for these properties, many experimental compounds containing mixed plasticizers and pure plasticizers were investigated.

Preparation of Samples

Reed (5) has shown that plasticizers vary considerably in their ability to soften vinyl chloride polymers. In order to compare plasticizers on an equivalent basis, he first determined the concentration of each plasticizer necessary to give a standard flexibility. Other properties of the plasticized compound were then compared at this concentration. To measure flexibility, he selected an autographic stress-strain tester similar in construction to that described by Williams and Sturgis (9). The plasticizer concentration necessary to give 100% elongation in 1 min. at 1000 p.s.i. at 25° C. was chosen as the standard.

Naturally, it is possible to use other methods of measuring flexibility or stiffness in defining the standard concentration. Probably the most convenient is the durometer hardness test. As described in ASTM D 676-42T, this test measures the indentation of a spring-loaded point into a thick sample of the plastic. A dial is connected to the point and the indentation read off in arbitrary units of 1 to 100. The instrument is available in two ranges for samples of varying hardness. The durometer "A" instrument, used in this work, is more suitable in the hardness range of plasticized vinyls. Because of the creep characteristics of vinyls, it is necessary to standardize on some arbitrary load application time. A dwell time of 15 sec. at 23° C. was used in obtaining the data given here. Smith (7) reported that this test actually measures the modulus of rigidity of the sample.

Typical data showing the effect of DOP (di-2-ethylhexyl phthalate) concentration on durometer "A" hardness appear in Fig. 1, p. 139. The standard durometer "A" hardness selected for most of the work reported here is 80. The concentration of plasticizer (expressed as parts by weight per 100 parts by weight of

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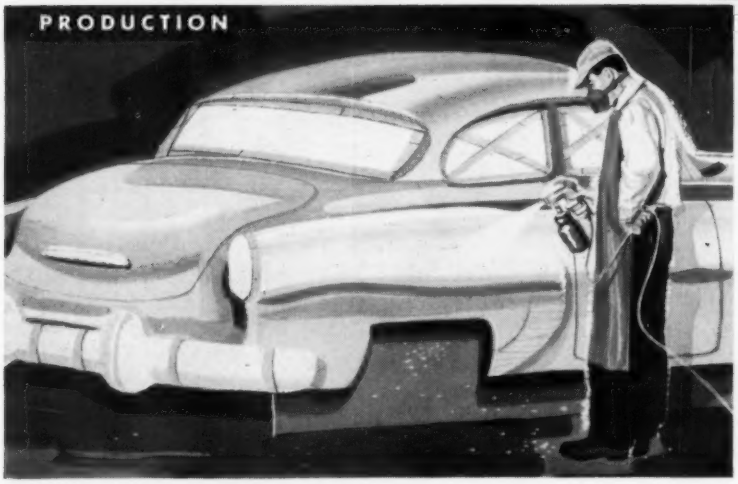

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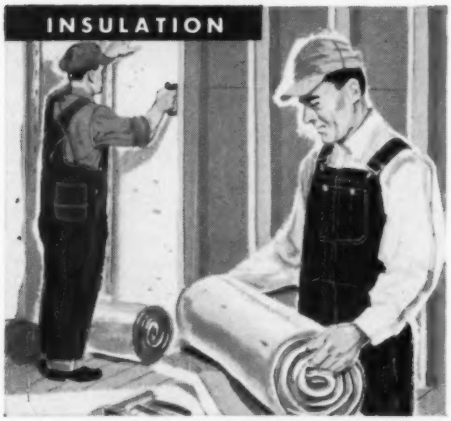

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Table IV—Properties of Mixed Plasticizer Compounds DOP, G-50, TOF

% of Efficiency Concentration[a]			Durometer "A"		Brittle Temp.		SPI Volatility		Rub-Off "K"	
DOP	G-50	TOF	Calc.	Found	Calc.	Found	Calc.	Found	Calc.	Found
					°C.	°C.				
100			—	79	—	—24	—	3.9	—	1.5
	100		—	87	—	—10	—	0.4	—	1.0
		100	—	85	—	—54	—	9.0	—	3.2
10	35	55	85	83	—35	—30	5.5	6.4	2.3	1.7
40	10	50	83	83	—37	—37	6.1	6.0	2.3	2.1
30	40	30	84	82	—24	—20	4.0	5.1	1.8	1.4
65	20	15	82	80	—26	—24	4.0	5.3	1.7	1.6
30	55	15	84	80	—21	—18	2.8	4.1	1.5	1.3

[a] Efficiency Concentration (Durometer "A" = 80)

DOP	=	48 p.h.r.
G-50	=	52 p.h.r.
TOF	=	44 p.h.r.

Table V—Properties of Mixed Plasticizer Compounds DOP, G-62, 4GO

% of Efficiency Concentration[a]			Durometer "A"		Brittle Temp.		SPI Volatility		Rub-Off "K"	
DOP	G-62	4GO	Calc.	Found	Calc.	Found	Calc.	Found	Calc.	Found
					°C.	°C.				
100			—	77	—	—24	—	4.2	—	1.8
	100		—	76	—	—18	—	0.7	—	1.3
		100	—	75	—	—34	—	6.5	—	6.6
20	5	75	75	75	—21	—28	5.8	6.0	5.4	4.6
10	25	65	75	77	—31	—38	4.8	4.6	4.8	4.6
40	20	40	76	78	—27	—30	4.4	4.1	3.6	3.2
15	50	35	76	77	—24	—26	3.3	2.9	3.2	2.9
65	20	15	77	78	—24	—24	3.9	4.3	2.4	2.0
35	50	15	76	77	—23	—22	2.8	3.4	2.3	2.2

[a] Efficiency Concentration (Durometer "A" = 80)

DOP	=	48 p.h.r.
G-62	=	54 p.h.r.
4GO	=	47 p.h.r.

Table VI—Properties of Mixed Plasticizer Compounds DOP, R-2H, TOF

% of Efficiency Concentration[a]			Durometer "A"		Brittle Temp.		SPI Volatility		Rub-Off "K"	
DOP	R-2H	TOF	Calc.	Found	Calc.	Found	Calc.	Found	Calc.	Found
					°C.	°C.				
100			—	63	—	—34	—	6.3	—	4.5
	100		—	62	—	—12	—	0.8	—	.8
		100	—	68	—	—64	—	11.3	—	7.2
60	20	20	64	66	—36	—34	6.2	6.4	4.3	3.8
25	40	35	64	64	—36	—30	5.8	6.7	4.0	3.1
10	25	65	66	67	—48	—48	8.2	8.3	5.3	3.6
25	10	65	66	67	—51	—52	9.0	8.4	5.9	5.0
20	70	10	63	66	—22	—22	3.0	4.5	2.2	1.8
10	80	10	63	66	—19	—18	2.4	2.9	1.8	1.4

[a] Efficiency Concentration (Durometer "A" = 65)

DOP	=	70 p.h.r.
R-2H	=	86 p.h.r.
TOF	=	64 p.h.r.

resin) required to give a durometer "A" hardness of 80 is called the 80-durometer efficiency concentration.

The formula used in preparing samples was:

Bakelite vinyl resin VYNW	100
Plasticizer	As shown
Dibasic lead phosphite	2
Dibasic lead stearate	1

Bakelite vinyl resin VYNW is a copolymer containing 96% vinyl chloride and 4% vinyl acetate. The plasticizers studied and their chemical compositions and sources of supply are given in Table I, p. 139. The Compounds which were plasticized with 4GO contained in addition to the above ingredients, 0.1 parts of bisphenol A [2,2-(p-hydroxyphenyl) propane] as an antioxidant. After thorough blending, the samples were milled at 170° C. for about 5 minutes. Part of the milled sheet was retained in order to make pressings for brittle temperature and durometer measurements; the rest was calendered into 0.004-in. film.

Test Methods

Durometer "A" data were measured by ASTM method D 676-42T, brittle temperatures by ASTM D 746-44T, and SPI volatilities by ASTM D 1203-52T. The rub-off test was described by Reed, Schulz, and Klemm (6). This test subjects a film to the rubbing and wicking action of a 50:50 mixture of "Hyflo Supercel" (diatomaceous earth) and "Si-o-lite" (dehydrated silicic acid). The rub-off "K" value is the loss in grams per square meter of sample surface divided by the square root of rubbing time in hours. Rub-off has been shown to be a measure of the diffusion rate of a plasticizer (4).

The nitrocellulose marring test used in this work is an adaptation by M. C. Reed[3] and R. H. Carey[3] of the swinging beam method for testing varnish films developed by Walker and Steele (8). Standard white nitrocellulose lacquer (M-60-WF2, Sherwin Williams Co.) is applied to a glass plate with a 0.003-in. clearance Bird film applicator. The film is dried overnight at room temperature and then at 60° C. for 2 hours. The hardness of this film is measured using the Walker-Steele beam. A photo of this beam is shown in Fig. 2, p. 142. The beam is started

[3] Bakelite Co., Products and Processes Department.

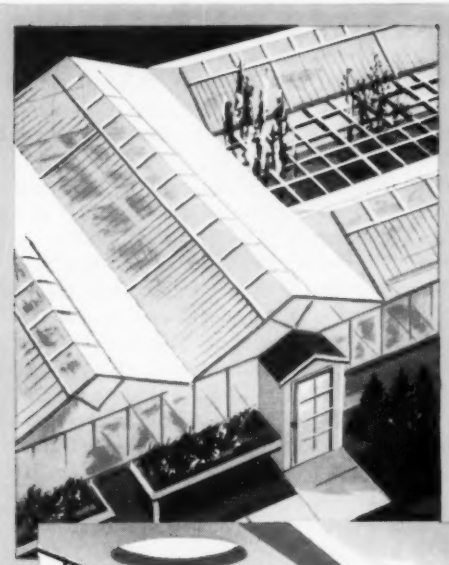

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Table VII—Brittle Temperatures of the DOP, G-62, 4GO System[a] A = DOP; B = G-62; C = 4GO

BT	c when a = 0	a when c = 0	a when b = 0
°C.			
—20	0.13	0.33	—
—25	0.44	—	0.90
—30	0.75	—	0.40

[a] a, b, and c are the fractional parts of the efficiency concentration of plasticizers A, B, and C, respectively.

oscillating manually and the time required for the oscillations to damp from an angular amplitude of 20 degrees to an amplitude of 10 degrees is recorded. With the help of a rubber "squeegee" roller, the vinyl film to be tested is then applied to the nitrocellulose. Weights are placed on the laminate to give a total pressure of 1 p.s.i. on the vinyl film. The assembly is placed in a 40° C. oven for 1 hr. or for 24 hr., depending on the marring tendency of the plasticizer. The specimen is removed and the nitrocellulose film is tested again for hardness by the swinging beam method. The percent softening is calculated by the equation

$$\text{Percent softening} = \frac{T_o - T}{T_o} 100$$

where T_o = time for amplitude to decrease 50% on unmarred nitrocellulose, and T = time for amplitude to decrease 50% on marred nitrocellulose.

Experimental Results

Several two-component plasticizer systems have been studied. For purposes of illustration, the data on TOF-DOP compounds are given here. TOF is a more efficient plasticizer and, at equal concentrations, it gives a softer compound. Therefore, adjustments were made in total plasticizer concentration to obtain compounds of equal durometer "A" hardness. The method by which this was done is readily apparent from Table II, p. 142.

The calculated values in Table II were obtained by assuming that the value of each property in the mixed compound is proportional to the relative concentration of each plasticizer. Within the experimental error of the measurements, it can be seen that all of the predicted values agree with those found for the mixed compounds.

The methods used to calculate the values in Table II can readily be generalized to include any number of plasticizers. The equation used to predict the value of a property, X, in a mixed compound containing plasticizers A, B, C, etc., at concentrations A′, B′, C′, etc., (expressed in parts per 100 parts resin) is

$$\bar{X} = \frac{A'}{E_a} \cdot X_a + \frac{B'}{E_b} \cdot X_b + \frac{C'}{E_c} \cdot X_c + \text{- - -}$$

where E_a = concentration in p.h.r. (parts per 100 parts resin) of A necessary to give a durometer hardness equal to that of the mixed compound, E_b = same for B, E_c = same for C; and where X_a = value of the property in a compound of A at a concentration E_a, X_b = same for B, X_c = same for C.

If the durometer "A" hardness of the mixed compound is 80, E_a, E_b, E_c, etc., represent the 80-durometer efficiency concentrations of plasticizers A, B, and C. In this case A'/E_a, B'/E_b, C'/E_c, etc., are the fractional parts of the 80-durometer efficiency concentration of each plasticizer in the mixed compound. It is obvious that A'/E_a, B'/E_b, C'/E_c, etc., represent a method of expressing plasticizer concentration. This method of specifying concentration is particularly applicable to mixed plasticizer compounds. A'/E_a, B'/E_b, C'/E_c, etc., are fractional parts of the efficiency concentration at the specified durometer.

The equation given above has been applied to three 80-durometer three-component systems and to one 65-durometer system. The 80-durometer systems studied were DOP, G-50, 9058; DOP, G-50, TOF; and DOP, G-62, 4GO. The 65-durometer system contained DOP, R-2H, and TOF. Data on these are given in Tables III to VI, pp. 142, 144. In general, the agreement between predicted and found values is very good. This is true despite the fact that certain of the plasticizer concentrations selected were incorrect and compounds deviating considerably from the desired 80-durometer hardness were obtained. The rub-off values on the mixed plasticizer compounds are generally slightly lower than the predicted values. The consistently lower values may indicate a trend toward a slight depression in rub-off for mixed plasticizer compounds.

Triangular Co-ordinate Representation

Triangular co-ordinate graphs are often used to describe certain properties of three-component systems. Graphical representation of compound properties by this method provides a means of showing how the properties vary with changes in the proportions of the component plasticizers. As has been shown experimentally in the preceding sections, compound properties vary linearly with the concentration (expressed as the fraction of the efficiency concen-

Table VIII—Nitrocellulose Marring of DOP, HB-40 Mixtures

Composition DOP	Composition HB-40	Marring (24 hr., 40° C.) Calc.	Marring (24 hr., 40° C.) Found
p.h.r	p.h.r.	%	%
30	15	—	10
34.5	11.2	16	17
39	7.5	22	19
43.5	3.7	28	26
48	0	—	34

Table IX—Nitrocellulose Marring of DOP, TOF Mixtures

Composition DOP	Composition TOF	Marring (1 hr., 40° C.) Calc.	Marring (1 hr., 40° C.) Found
p.h.r.	p.h.r.	%	%
36	11	—	31
24	22	49	40
12	33	68	77
0	44	—	86

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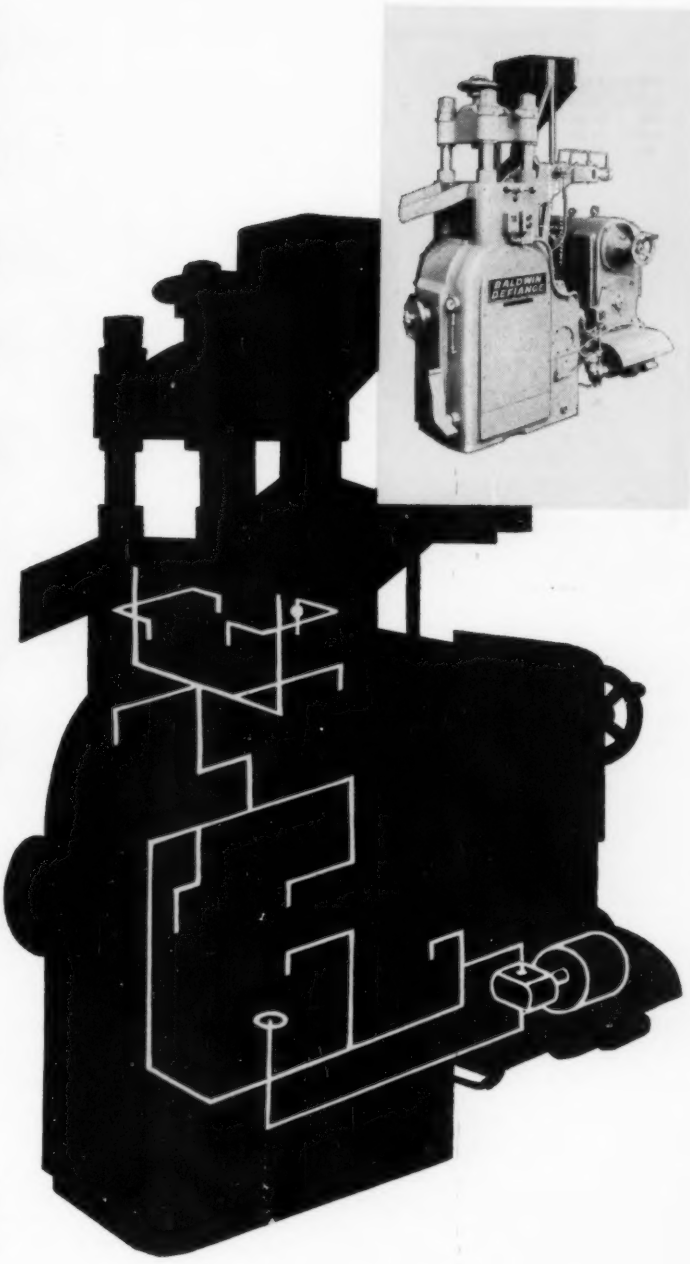

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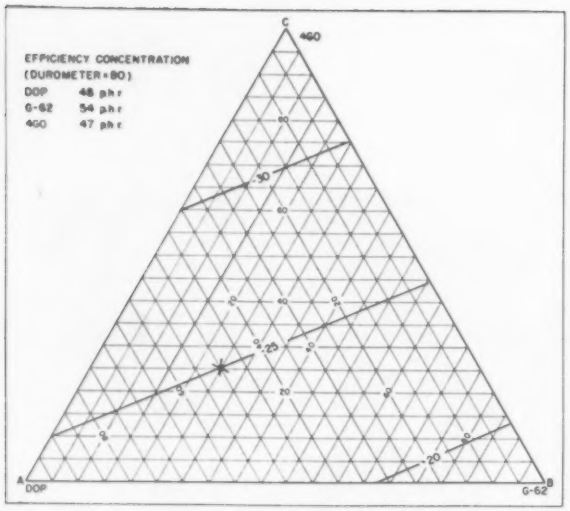

Fig. 3—Triangular co-ordinate graph showing brittle temperatures of 80-durometer compounds containing DOP, G-62, and 4GO

tration) of each plasticizer. Therefore, a plot of all possible compositions that will give some definite property value (for example, a brittle temperature of −25° C.) will fall on a straight line. This is illustrated for the brittle temperature properties of the 80-durometer DOP, G-62, 4GO system in Fig. 3. The co-ordinates used in this triangular graph are the fractional parts of the 80-durometer efficiency concentration of each plasticizer, A'/E_a, B'/E_b, and C'/E_c. In the graph the co-ordinate "a" corresponds to A'/E_a, the co-ordinate "b" to B'/E_b, and the co-ordinate "c" to C'/E_c. Plasticizer A is DOP, B is G-62, and C is 4GO.

As can be seen in this graph, a −25° C. brittle temperature can be obtained with a compound containing only DOP and 4GO. This compound will have the formulation:

Bakelite vinyl resin VYNW 100
Flexol plasticizer DOP 0.90 × efficiency concentration of DOP = 0.90 × 48 × 43 p.h.r.
Flexol plasticizer 4GO 0.10 × efficiency concentration of 4GO = 0.10×47 = 5 p.h.r.

Similarly, a compound containing only G-62 and 4GO which will have a −25° C. brittle temperature, will have the composition

Bakelite vinyl resin VYNW 100
Paraplex plasticizer G-62 0.56× efficiency concentration of G-62 = 0.56×54 = 30 p.h.r.
Flexol plasticizer 4GO 0.44×efficiency concentration of 4GO = 0.44 ×47 = 21 p.h.r.

It is obvious from the graph that it is not possible to make an 80-durometer compound containing only G-62 and DOP that will have a brittle temperature of −25° C. There are an infinite number of intermediate compositions containing all three plasticizers that will have a −25° C. brittle temperature. One of these, illustrated by the cross on Fig. 3, will have the composition:

Bakelite vinyl resin VYNW 100
Flexol plasticizer DOP 0.50×48 = 24 p.h.r.
Paraplex plasticizer G-62 0.25×54 =13.5 p.h.r.
Flexol plasticizer 4GO 0.25×47= 12 p.h.r.

Other properties can be plotted similarly. When these are superimposed on the brittle temperature graph (see Fig. 4, below), a comprehensive picture of the properties obtainable with any 80-durometer combination of these plasticizers is obtained. Similar property graphs for the other three component plasticizer systems studied are shown in Figs. 5, 6, and 7, below and p. 153.

In Figs. 4 through 6 it will be noted that the efficiency concentrations upon which the graphs are based are in some cases different from those used in the experimental compounds described in Tables III, IV, and V. Since some of the experimental compounds deviated considerably from 80-durometer, this adjustment is necessary in order that comparisons between plasticizers be made on an equivalent basis. The

(*To page* 153)

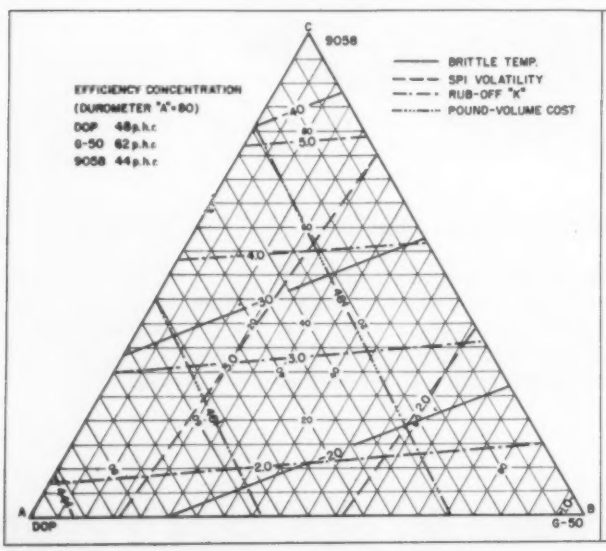

Fig. 4—80-durometer compounds containing DOP, G-50, and 9058

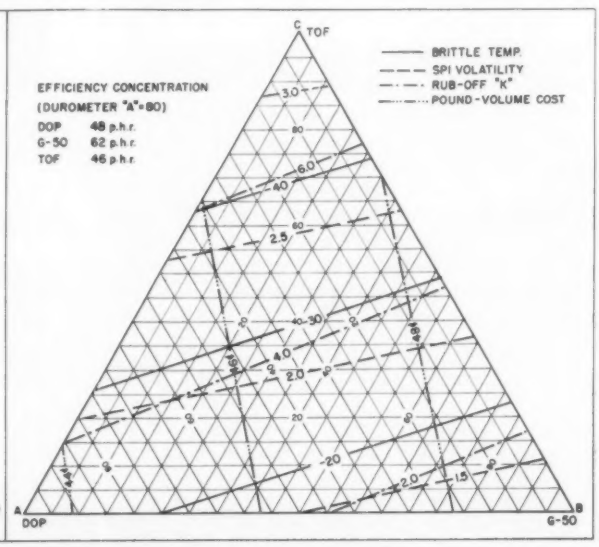

Fig. 5—80-durometer compounds containing DOP, G-50, and TOF

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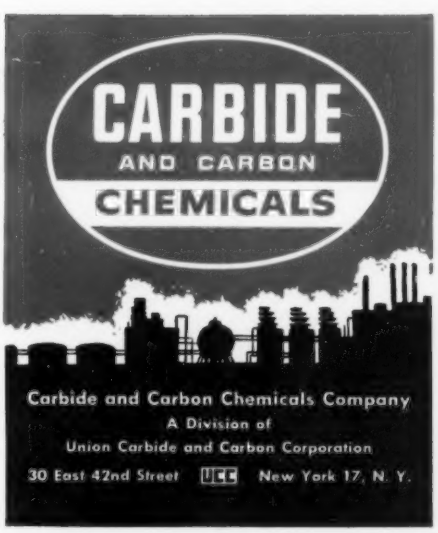

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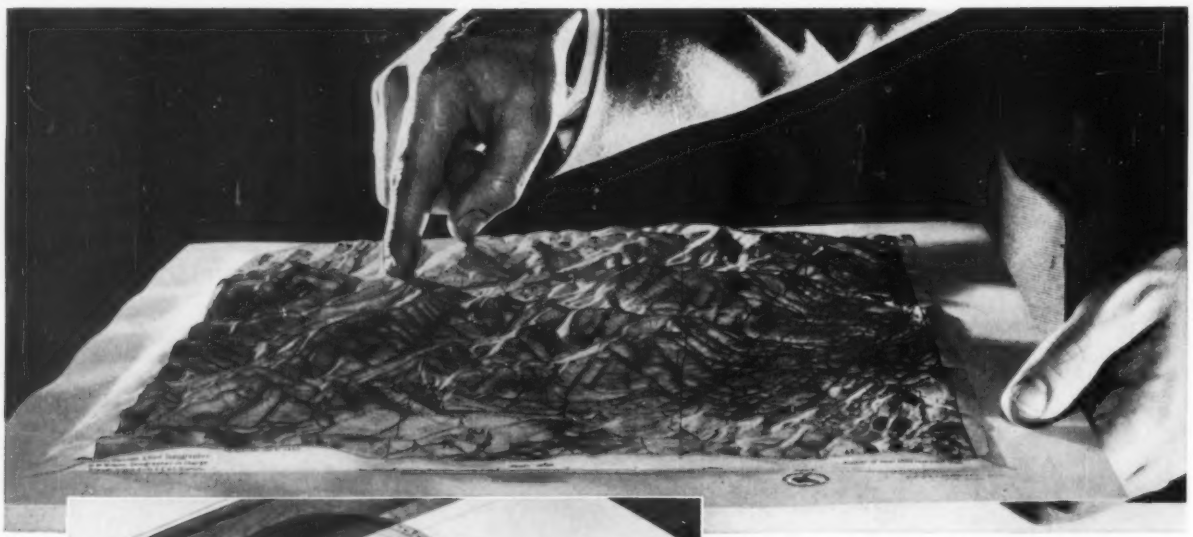

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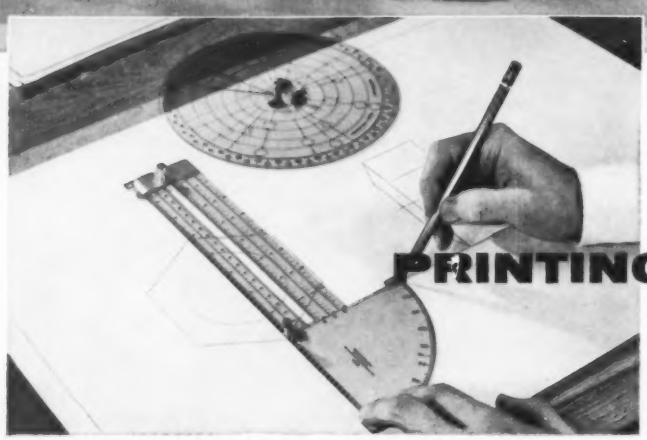

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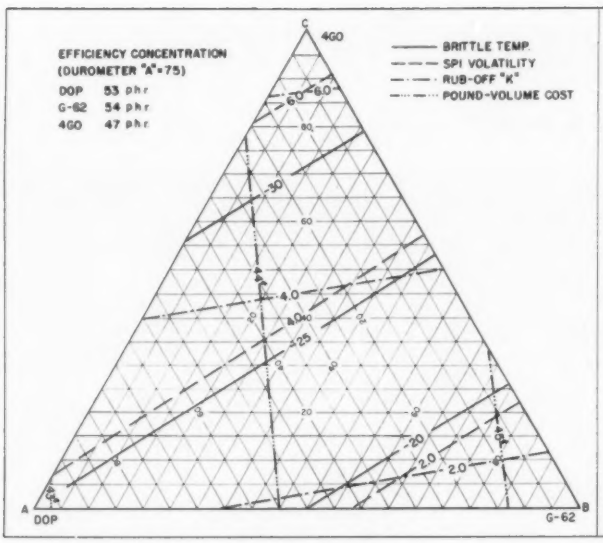

Fig. 6—75-durometer compounds containing DOP, G-62, and 4GO

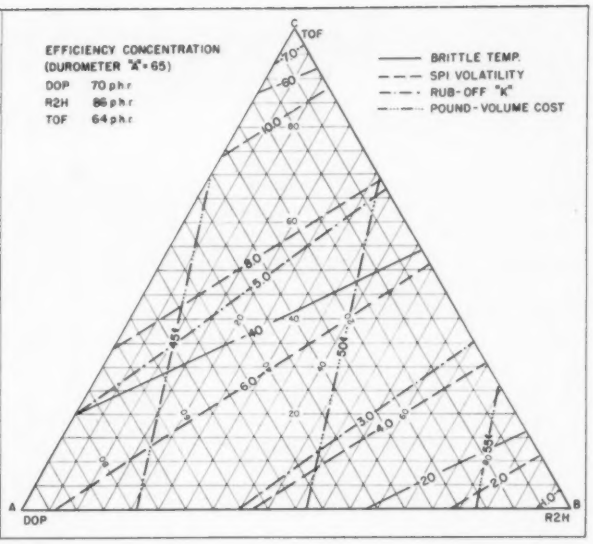

Fig. 7—65-durometer compounds containing DOP, R2H, and TOF

property values used in the graphs are taken at the new concentrations.

It should be possible to use graphs of this type in the first stages of formulation work on new compounds.

It will be noted that one of the properties plotted in Fig. 4 is the pound-volume cost of the compound (with no stabilizers or fillers). The pound-volume cost is the price of a volume of compound equal in volume to 1 lb. of water. Naturally, the pound-volume cost is more meaningful to fabricators who sell on a volume rather than a pound basis. The price of a compound quoted on a cost-per-pound basis obeys the equations previously developed for other properties as long as the cost of the resin is included as one term in the equation. However, because of the way these things behave mathematically, pound-volume cost does not follow this simple relationship. An exact pound-volume cost equation can be derived quite simply. The equation obtained is

$$\overline{P'} = \frac{100\,P_r + a \cdot E_a \cdot P_a + b \cdot E_b \cdot P_b + c \cdot E_c \cdot P_c}{\frac{100}{d_r} + \frac{a \cdot Ea}{d_a} + \frac{b \cdot Eb}{d_b} + \frac{c \cdot Ec}{d_c}}$$

where $\overline{P'}$ = cost per pound-volume of the mixed compound; P_r, P_a, P_b, and P_c are the cost per pound of the resin and the plasticizers A, B, and C, respectively; d_r, d_a, d_b and d_c are the densities of the resin and the plasticizers A, B, and C; and a, b, and c are the fractional parts of the efficiency concentration of plasticizers A, B, and C.

(Plasticizer and resin costs as of 10/29/'54 were used in the graphs shown here.)

Two equations are used in calculating the triangular co-ordinate graphs:

$$\bar{X} = a \cdot X_a + b \cdot X_b + c \cdot X_c$$

and

$$a + b + c = 1$$

When

$$c = 0$$

$$\bar{X} = a \cdot X_a + (1-a) \cdot X_b = a(X_a - X_b) + X_a$$

and

$$a = \frac{\bar{X} - X_b}{X_a - X_b}$$

Similar equation can be obtained for a or c when $b = 0$ and for b or c when $a = 0$. These equations were used in calculating Table VII, p. 000, which illustrates the method for brittle temperatures ($\overline{BT}$) of the 4GO, DOP, G-62 system. These points are plotted on the triangular co-ordinate graph and straight lines drawn through all equal brittle temperatures. The $\overline{BT}$ values are selected arbitrarily. The usual procedure is to select values so that there will be about four intervals between the plasticizer with the highest brittle temperature and the plasticizer with the lowest brittle temperature.

Nitrocellulose Marring

Nitrocellulose marring apparently can also be predicted by these methods. Data on DOP, HB-40 and on DOP, TOF mixtures are given in Tables VIII and IX, p. 146. Table VIII does not contain data on an all DOP compound since pure DOP does not mar nitrocellulose sufficiently in 1 hr. at 40° C. to give meaningful data.

Acknowledgment

The author is indebted to his colleagues of the Bakelite Co.'s Product and Processes Development Laboratories, especially M. C. Reed and the late W. J. Jebens, for many helpful suggestions.

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Trends in Styrene Plastics

by RICHARD B. BISHOP*

REVIEWS appear about this time each year and they are a good thing. They serve the purpose of summarizing the year's accomplishments and of listing some of the more outstanding advances. Many people are aware of these individual items but a report of this kind is valuable in bringing together much of the isolated knowledge in a factual presentation which together adds up to the trends and growth in which we are all so vitally interested.

Technical advances in styrene polymers, copolymers, and alloys will be summarized here. This survey will follow a progressive plan from raw materials and manufacture of the polymer to the finished product, thus touching on raw materials, derivatives of styrene, polymerization, copolymerization, internal and external modification, and molding practices.

Courtesy Koppers Co., Inc.

Two radio cabinets, molded in same mold but of different styrenes, after having been immersed for 10 min. in boiling water. Light-colored cabinet, molded of heat-resistant styrene, is unaffected; dark cabinet, made of general-purpose material, is badly distorted

Raw Materials

The alkylation, dehydrogenation, and purification processes used at present in the preparation of styrene monomer and the current yield of 85 to 89% of theory preclude much possibility for improvement in this direction. They are well engineered procedures as their high yields testify. Other petroleum cuts more plentiful and available at lower prices are not numerous.

Toluene already has been used instead of benzene in making a cousin to styrene. The Dow Chemical Co. and American Cyanamid Co. make vinyltoluene by different methods. Unfortunately, the alkylation step produces mixtures of ortho, meta, and para isomers. The Dow process isomers are mainly para and meta and the American Cyanamid isomers are mainly ortho and para. The preferable isomer is the para which yields a polymer of about 118° C. softening point. The possibility of separation is very poor, but five years ago the same could have been said of the isomers of xylene and now look at the advances which have been made. Perhaps someone will find a process for the pure paravinyltoluene. Although the immediate potential of the vinyltoluene materials is less than that of styrene, the present mixtures will find use in the rapidly expanding fields of paint, latex, adhesives, and bonding agents. Also, their possibilities as extenders in the epoxies and polyesters should not be overlooked.

Other raw materials used in the manufacture of modified monomers are those produced by chemical change in the styrene or ethylbenzene itself. Thus, chloro, alphamethyl, nitro, cyano, amino, and numerous other derivatives have been made in the past. An economical process for the preparation of the chloro compounds could open up a vast field of possibilities for this monomer, especially in the coating field when fire retarding characteristics are necessary. Polymer from the chlorinated material also has a very high melting point. The organic chemists of many large companies have already abandoned most of these derivatives for modification of styrene along other lines mentioned below.

Modifications that can be made in polymerization of styrene are the ones of current interest. These changes in polymerization methods control changes in the actual polystyrene produced. The processes of manufacture—mass, emulsion, and suspension—need not be treated here but the generalizations made will apply to all.

Polymerization

The more completely the monomer is converted into polystyrene, the higher is the heat distortion temperature of the molded piece. However, the removal of this monomer has an adverse effect, in that it causes the material to have a harder flow. Actually, high heat distortion materials have been produced by simply removing monomer by vacuum, for example. Some work has been done in double catalyst materials, which almost completely polymerize the monomer to give better products.

The apparent molecular weight and the molecular weight distribution in the polystyrene produced has in the past few years been reduced. The molecular weight of the polystyrene is usually between 60,000 and 100,000 and usually the variation in ranges of molecular weight are within 15 percent. Thus, a more uniform product is produced as

* See portrait and panel on p. 156

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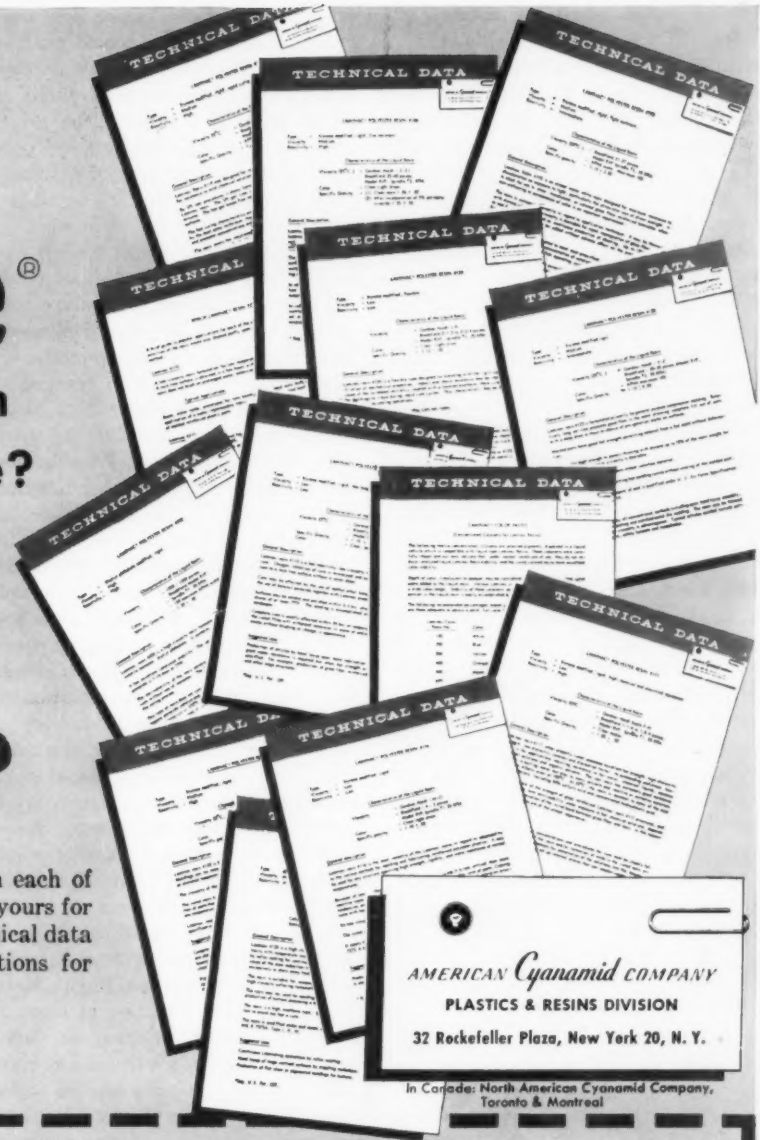
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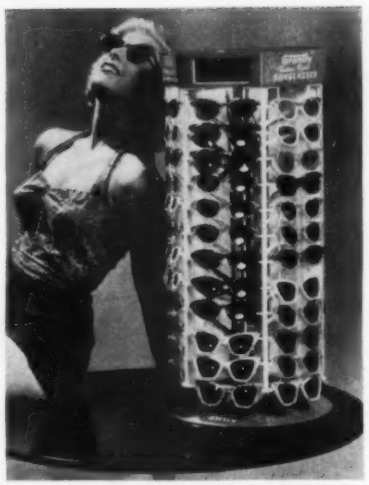
The increase in the heat distortion temperature of the polymer allowed us freedom of manipulation to produce high flow materials. These materials have been made by 1) controlling the molecular weight and monomer content at a point where a good heat distortion temperature is obtained, and 2) incorporating in the polymerization process 2 to 3% of a plasticizer that will not appreciably lower the heat distortion temperature. Naturally the selection of this material is not easy, but each major manufacturer has hit upon one or more materials that will perform this task. It will be noted that the materials manufacturers first announced high heat distortion material and then the easier flow materials. The extent to which modifications in the current polymerization processes can control quality is about limited to these three properties: 1) completion of reaction, 2) size and distribution of molecule produced, and 3) plasticizing of the polymer produced.

Future polymerization process advances will be in the speed of polymerization techniques. The creation of free radicals and chain initiators by light, X-ray, and atomic radiation might make our reaction proceed at faster rates if methods are developed to remove more rapidly the heat generated in the polymerization step. Although the rate of reaction is proportional to the square root of initiation, the molecular weight is inversely proportional to this factor. Fortunately, in initiation by such energy sources, we have a means that is also effective at low temperatures where adverse thermal effects can be avoided and molecular weight can be controlled over a wide range. Unfortunately, the benzene ring in styrene is capable of resonance, which dissipates some energy, thus requiring larger doses to get results. A great deal of work along these lines is being done currently. Possibly exposure of a thin film of liquid over a drum to a certain wavelength of light while subjected to refrigeration might be a future method. The use of dyes to sensitize polymerization to light energy has already become a reality. Ultrasonics have been used in sugar crystallizations and reactions and there is hope that such energy could also polymerize materials. Recent reports have indicated that some depolymerizations occur at high electrical frequencies. These are all in the preliminary stage of development.

Methods of polymerization with high temperature peroxides are interesting. Styrene droplets sprayed into reaction chambers kept under control by a spray of water, the vaporization of which will remove the large amounts of heat generated by polymerization, is an attractive possibility in the use of these high-temperature peroxides. What about the nature of materials produced exclusively at these higher temperatures? These temperatures would be below thermal degradation temperatures, but certainly the polymers would be different from our current production materials.



Courtesy Foster Grant Co., Inc.

Sunglass rack, made of high-impact polystyrene material, was undamaged after a fall of four stories on concrete

Copolymerization

Copolymerizations in which two or more monomers are polymerized together have been studied for a long time. Numerous types of such copolymers are currently being described in the literature. The new block and graft polymers are out of the laboratory stage and now command some interest. Special types and properties of one material can be added onto the backbone of another material without changing the essential nature of the backbone. A new material made in this manner will be entirely different in properties than one made using the same ratios of monomers in the usual process. Block polymers, consisting of a string of units of one monomer followed by a string of units of another monomer alternately in the chain, will be more flexible and possess different flow properties than the same ratios of monomers polymerized at random. Synthesis of block and graft copolymers is a two-step procedure. The blocks must be made before linking or grafting is done. Tailor-made materials are a natural for this field.

These two techniques are among the most promising new methods of our chemists from which a whole host of materials will be appearing in the future. Already, graft poly-

(*To page* 234)

THE AUTHOR

Richard B. Bishop, director of chemical research at Foster Grant Co., Inc., is one of the most active personalities in the plastics industry. After receiving his B.S. in chemistry from Holy Cross College and taking post-graduate work in organic chemistry at Johns Hopkins, Mr. Bishop became associated with the Research and Development Dept. of Socony-Vacuum, where he attained the position of chief research chemist, prior to establishing his present affiliation.

Mr. Bishop is a member of the American Chemical Society, a national director of The Society of Plastics Engineers, and honorary chairman of the 1955 S.P.E. Convention. He has held numerous other offices in the past. He has to his credit 36 U. S. patents, with 10 others still pending.

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Materials

PRESENT AND FUTURE APPLICATIONS OF HEAT-RESISTANT MODIFIED POLYSTYRENE. C. J. Snyder. SPE J. *10*, 38-39, 50-51 (May 1954). Some properties of the heat-resistant modified polystyrenes are compared with polystyrene and applications of the modified polymers are enumerated. The modified polystyrenes are tougher and more elastic than regular polystyrene and are available in a heat-resistant grade, greatly widening the range of applications. Applications include radio cabinets, storage batteries, and television tube masks.

APPLICATIONS FOR RUBBER-MODIFIED STYRENE MOLDING COMPOUNDS. E. V. Hellyar. SPE J. *10*, 34-37 (May 1954). The rubber-modified styrene compounds, while retaining essentially all of the properties of general-purpose styrene, have added strength and toughness evidenced not only by improved impact but also ultimate elongation and flexural fatigue. Applications for these materials are listed, including toys and housewares, refrigerators and home freezers, housings for numerous appliances such as air conditioners, air-circulators, radio and television sets, and batteries.

STYRENE ACRYLONITRILE COPOLYMERS. J. S. Whitaker. SPE J. *10*, 30-33, 54 (May 1954). The properties of the styrene acrylonitrile copolymers are discussed and processing data are presented. These copolymers have higher mechanical strength, better weather resistance, and generally improved chemical properties compared to polystyrene. They differ from polyacrylonitrile in that they can be molded, extruded, and calendered with conventional equipment. Much of the existing injection molding equipment for the molding of polystyrene can be used for acrylonitrile-styrene copolymers with an upward adjustment of molding temperatures. These copolymers can be calendered on conventional equipment regularly used for vinyl compounds. Typical conditions are listed for these two types of processing and for extrusion. These copolymers have good toughness, dimensional stability, moderately good weather resistance, and resistance to oils and greases as well as many common cleaning materials. Among the applications are hair driers, dishware, cutlery handles, camera housings, and refrigerator components.

IRRADIATED POLYETHYLENE. J. B. Campbell. Materials & Methods *40*, 91-95 (Sept. 1955). When polyethylene, ordinarily thermoplastic, is bombarded by high-energy electrons, it becomes a new, infusible material that is now undergoing industry evaluation. The first commercially available irradiated polyethylene is General Electric's Irrathene 101 which is only lightly cross-linked to preserve the flexibility and toughness of the conventional plastic; it is presently available only in the form of tape. Irrathene 101 differs from conventional polyethylene in that it has no melting point (since it is thermoset), exhibits no stress-cracking, holds its shape, is elastomeric at elevated temperatures, and possesses better dielectric strength and solvent resistance than does ordinary polyethylene at elevated temperatures. In most other respects, such as tensile strength, toughness, heat aging, and dimensional stability at elevated temperatures (except as noted previously), irradiated polyethylene does not differ significantly from conventional polyethylene. Irradiated polyethylene has some important limitations: it cannot be injection molded or extruded, since it is thermoset; it is presently limited to thin cross-sections because of the limited depth of penetration attainable with the electron beam; it is not likely to be available in a broad range of colors, since most dyes are affected by irradiation, and it is at present an expensive material. Applications are expected primarily where the excellent electrical properties, moisture resistance, toughness, and other properties of conventional polyethylene are required along with form stability above 230° F. or outstanding resistance to stress cracking.

EFFECT OF VARIOUS ADDITIVES ON UNSATURATED POLYESTER RESINS. B. Berndtsson and L. Turunen. Kunststoffe *44*, 430-36 (Oct. 1954). The term "unsaturated polyester resin" is defined for the case of a styrene-modified resin and the curing process is analyzed. The effects of catalysts on the activation of the double bond, the effect of the accelerator on the formation of the radical, the effect of the styrene concentration on the gelation time, and the properties of the cured resin were investigated. The effect of 90 pigments on many properties, such as gelling time, Rockwell hardness, and other properties is tabulated.

SOME PROBLEMS IN THE DISPERSION OF PIGMENTS FOR PLASTICS. P. Lowe. Brit. Plastics *27*, 304-06 (Aug. 1954). The problem of supplying pigments dispersed in plasticizers and other media for the plastics industry presented certain features peculiar to the plastics industry. One consideration was how to evaluate a pigment dispersion in the laboratory. The fineness-of-grind gage was adopted together with microscopic examination and later supplemented with plate rub-outs and paper filtration. Another problem was that of aggregates in the final dispersion, which can lead to color shading if not adequately reduced. The wide range of dispersions required today requires something more than the traditional paint-processing machinery.

Molding and Fabricating

VACUUM FORMING DEVELOPMENTS IN BRITAIN. Plastics (London) *19*, 253-54 (Aug. 1954). A natural outlet for vacuum formed thermoplastic sheet is in the display field. There are, however, two principal difficulties involved in printing and then forming sheet materials. First, special inks are required that will adhere to such plastics as polyvinyl chloride and cellulose acetate. Sec-

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ond, during the forming process uneven movement of the sheet may result in lack of register on the flat surfaces and the parts in relief. This problem is alleviated by marking a formed sheet with the colors to be used, reducing the sheet to its original flat profile, and using this sheet as the printing guide.

PROGRESS IN POLYTHENE BOTTLE MANUFACTURE. Plastics (London) *19*, 250-52 (Aug. 1954). The mass production of polythene bottles falls into three categories: 1) Injection molding and sealing; 2) Injection molding and blowing; 3) Extrusion followed by blowing. New semi-automatic and automatic extrusion machines for the production of polythene bottles are described; these can produce bottles of different capacities and different shapes at the same time.

Applications

PLASTICS FOR DUAL-PURPOSE GEAR MATERIAL. M. R. Alexy. Elec. Mfg. *54*, 107-09 (Oct. 1954). A stringent set of tests was made on a variety of plastics materials in a quest for a material for gears required to serve in a dual capacity: 1) to transfer mechanical motion, and 2) to isolate a relatively high r-f voltage. Additional requirements were that the material have an operating range from −55 to 85° C., that it be resistant to water absorption, surface wetting, fungus growth, thermal shock, mechanical shock, and vibration, and that it have good dimensional stability. Each material was subjected to a high voltage test, a torque test, and a life test. Among the materials rejected were nylon, epoxy, polytetrafluoroethylene, sintered glass, melamine, slate, mica, talc, polyester, cotton fabric-phenolic laminate, and cotton fabric-melamine laminate. The recommended materials for the intended application, in the order of preference, were: 1) glass fabric-Teflon laminate, 2) glass fabric-silicone laminate, and 3) Kel-F. Each of these has advantages not found in the others. The glass fabric-Teflon laminate, though the poorest of the three on the torque test, held up best during the life test. The glass fabric-silicone had a tendency to delaminate at high temperatures. The average life of the Kel-F gears was less than that of the other two materials, but the Kel-F has the advantage of good machining properties and moldability.

PLASTICS IN THE FOUNDRY. Canadian Plastics *1954*, 54-56 (Sept./Oct.) A new method of casting molds is described that cuts production costs while yielding improved products. In the foundry, the usual heavy duty equipment and enormous molds are replaced with a lightweight shell mold made from a sand-filled phenolic resin. The wafer-thin molds are prepared by placing a mixture of sand and phenolic resin over a steel master mold, heating rapidly to curing temperature, and then removing the mold. To withstand the pressures generated when the mold is filled with molten metal, the wafers are placed in metal cans and surrounded by magnetized steel shot. The phenolic resin is eventually burned out by the molten steel, but not until the metal has chilled and set. After cooling, the mold and metal are withdrawn from the shot, the mold is peeled off, and the casting is ready for sale or use. The close tolerances to which castings can be made by this process practically eliminate the need for machining for many applications, such as gears, radar equipment, and many airplane parts.

Coatings

SYNTHETIC LATEX SCRUB-RESISTANT INTUMESCENT COATINGS. I. J. Cummings. Ind. Eng. Chem. *46*, 1985-91 (Sept. 1954). An intumescent, fire-retardant composition was selected from a study of three-component systems investigated on a trilinear diagram. The most useful system contained monoammonium phosphate, dicyandiamide, and pentaerythritol. A synthetic latex binder of the vinyl chloride-vinylidene chloride type was selected for the intumescent coating system from a group of twelve different types. The data indicate that good wet scrub resistance and fire resistance are obtainable over a wide range of latex binder content. The synthetic latex binder is utilized without a plasticizer and requires a drying schedule sufficient to coalesce the latex polymer particles. As scrub resistance of the intumescent coating film is dependent upon fusion of the latex binder, considerable care must be taken to dry the wet coating properly. Short drying schedules are recommended, utilizing temperatures near the fusion temperature of the latex, i.e., 330° F. Atmospheric conditions of high temperature and high humidity were simulated by accelerated testing of the latex-based intumescent coating at 90° F. and relative humidity 90 per cent. The data indicate that a 20 to 25% synthetic latex binder level imparts good resistance to accelerated tests designed to cause failure of the intumescent coating film. The formulating procedure for preparation of the latex-based intumescent coating is simple and direct. A high speed stone mill is used to prepare the aqueous dispersion in a quick and efficient make-up procedure. A short mixing period is required to blend the synthetic latex with the aqueous dispersion. Aging characteristics of the finished wet coating mix are not critical for factory manufacture. Storage and handling up to two weeks can be accommodated satisfactorily.

Properties

PILE IRRADIATION OF POLYETHYLENE. M. Dole, C. D. Keeling, and D. G. Rose. J. Am. Chem. Soc. *76*, 4304-11 (Sept. 5, 1954). Polyethylene in the form of film and granules was irradiated, both *in vacuo* and in air, in the heavy water pile of the Argonne National Laboratory, and the composition of the evolved gas, stress-strain relations, and tensile strength were determined. Bromine absorption, infra-red absorption spectra, extent of gel formation, and solution viscosities were measured as a function of the duration of irradiation. Most of the data were obtained with the vacuum-irradiated specimens. The first noticeable composition change was the disappearance of the vinylidene group as hydrogen was evolved; this decrease in unsaturation was more than compensated by the formation of the vinylene group. Seventy to 80% of the hydrogen evolution produced unsaturation, the rest produced cross linkages. From the composition of the evolved gas, it is estimated that C—C bonds along the side chains were ruptured about half as frequently as C—H bonds, but much more frequently than C—C bonds along the main hydrocarbon chain. The viscosity-average molecular weight of the soluble fraction at first increased slightly, but then decreased to a third of its original

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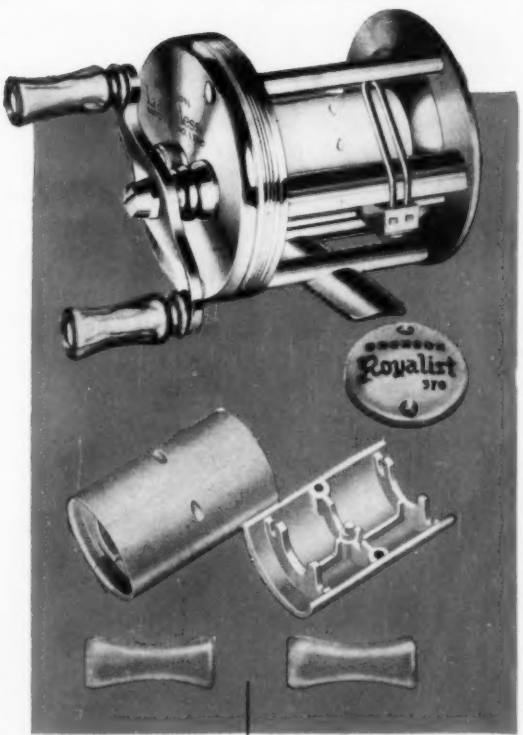

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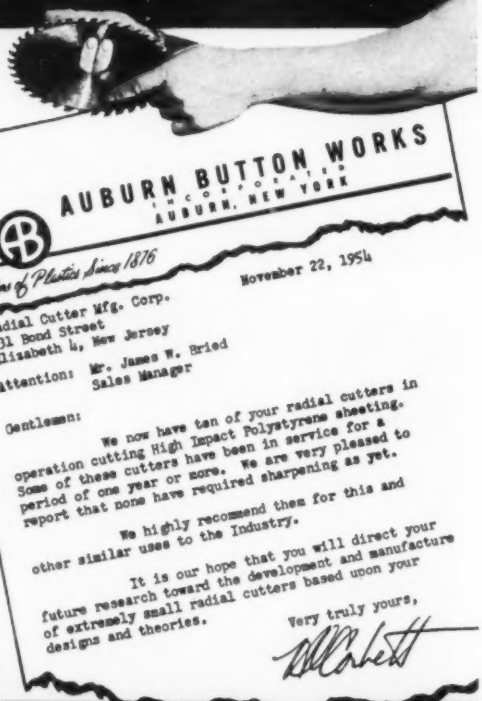
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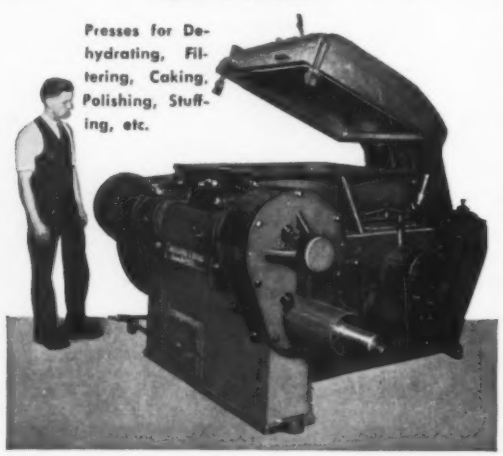

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NATURAL RUBBER AND GR-S VERSUS CORROSION. J. P. McNamee. Chem. Eng. *61*, 234, 236, 238, 240, 242, 244, 246, 248 (Aug. 1954). The subject of natural rubber and GR-S synthetic rubber as corrosion-resisting materials is comprehensively discussed. The corrosion resistance and physical properties of these two types of rubber are very similar. Both soft and hard forms find many uses in chemical processing. Their chemical resistance to more than a hundred different materials, including acids, bases, salts, and organic solvents is presented in the form of graphs.

DIELECTRIC STRENGTH OF SOLID INSULATION. J. J. Chapman and L. J. Frisco, Elec. Mfg. *53*, 136-43 (May 1954). A detailed investigation of the dielectric strength as a function of frequency of the applied electrical stress for 22 materials, including ceramic types, laminated thermosetting plastics, molded thermosetting plastics, and rigid thermoplastic resins, was made. Power sources of 3-kw. capacity or more were used to develop high voltages covering a range from 60 cycles to 100 megacycles. Dielectric strength is reported in the direction perpendicular to the sheet or disk surface and also parallel to the surface. The test methods and apparatus are described in detail. The results obtained are interpreted in relation to design requirements.

CRAZING IN POLYSTYRENE PARTS. E. E. Ziegler. Materials & Methods *39*, 93-97 (June 1954). The results of a test program designed to clarify some of the unknowns in the crazing of polystyrene and to provide information to aid in the selection of plastics materials and designs for satisfactory functioning over long periods of time under adverse conditions are reported. A new crazing test was employed to measure the critical elongation, i.e., that elonga-

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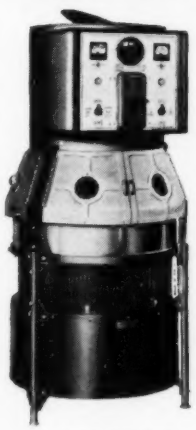

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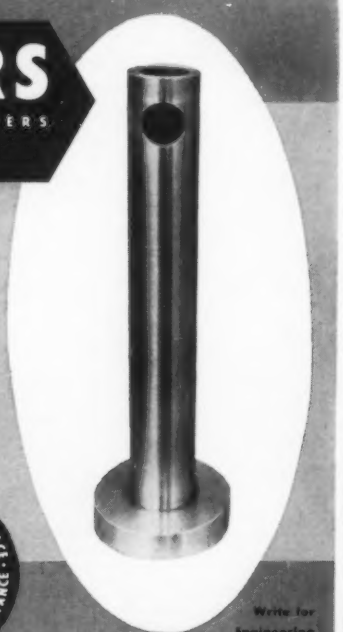

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tion at which, under a particular set of conditions, crazing is known to start. In this test, bars of plastic were clamped over bending forms designed to provide a constantly changing radius of curvature and corresponding strain in the specimen. Heavy crazing observed in the highly strained portions of the bar could be followed out into the less strained portions until the location of the last significant craze mark could be established and the critical elongation accurately determined. Critical elongation or strain can be converted into terms of stress, or vice versa, by means of regular stress-strain curves for polystyrene, thus indicating that value of tensile stress below which even the weakest part of the molding will perform satisfactorily but above which it may craze. Critical elongation measurements were used to determine the effects of time, temperature, light, and various reagents on the crazing of polystyrene.

Testing

A NEW METHOD FOR TESTING THE BLOCKING RESISTANCE OF TOP COATS FOR PVC UPHOLSTERY MATERIALS. H. E. Frey. Kunststoffe *44*, 337-40 (Aug. 1954). In this method a specimen of polyvinyl chloride plastic upholstery material that is provided with a top coat is inserted in a metal ring. Glass beads with a diameter of approximately 20 to 25 mm. are pressed on the freshly applied coating and the specimen is weighed with and without the adsorbed beads. The test is reproducible to within ±10% and requires only ½ hr. to carry out.

RAPID IDENTIFICATION OF WET-STRENGTH RESINS IN PAPER. J. C. Barthel. Paper Trade J. *138*, 24 (Sept. 10, 1954). A rapid spot test for indicating the presence of urea or melamine-formaldehyde resins in paper is described. Two solutions are employed. First, a drop of a 1% solution of phenylhydrazine in sulfuric acid-water is spread on the paper over an area about the size of a quarter. After 30 sec., excess liquid is removed with a blotter and a drop of the second solution (10% ferric chloride in water) is added. If either resin is present, a pink to red or reddish-brown color will develop. In the first step, the resins are hydrolyzed to liberate formaldehyde which immediately forms for-

maldehyde hydrozone; upon the addition of the second solution, the hydrozone is converted to an intensely-colored iron complex. With urea-formaldehyde resin the final color develops more quickly and to a deeper shade than with melamine-formaldehyde, thus, with experience, the two resins can be distinguished.

THICKNESS MEASUREMENTS OF THIN FILMS BY MULTIPLE-BEAM INTERFEROMETRY. T. W. Bartlett and F. L. Ball. U. S. Atomic Energy Commission Report K-1135 (June 16, 1954). Two techniques are described for the measurement of the thickness of thin films by multiple-beam interferometry. Of these, the more useful was fringes of equal chromatic order. The standard deviation of replicate measurements of films less than 1000 A. thick was rarely greater than 50 angstroms. Deviations of this magnitude can be explained on the basis of the precision of measuring wavelengths with the spectometer used. This evaluation is summarized as follows: 1) Well-defined topographical features such as sharp ridges, facets, or discontinuities may be observed by means of Fizeau fringes. 2) Thickness measurements may be made of evaporated metal films that can be silvered. These measurements are probably accurate to within 15% of the film thickness for the range from 100 to 1000 angstroms. 3) Thickness measurements of thin plastic films can be made with about the same accuracy as for metal films. 4) It is possible to remove thin plastic films from glass substrates, transfer to a glass slide, evaporate silver over the film, and determine a thickness for the stripped film that agrees reasonably with the thickness as measured before transfer.

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POLYMERS. T. Boyd (to Monsanto). U.S. 2,689,858, Sept. 21. Organotitanium polymers.

POLYSILOXANES. C. A. Burkhard (to General Electric). U.S. 2,689,859, Sept. 21. Chlorinated organopolysiloxanes.

POLYMERIZATION. W. A. Denison and E. W. Wise (to Carbide and Carbon). U.S. 2,689,872, Sept. 21. Polymerizing chlorotrifluoroethylene.

MOLDING. A. J. Roger. U.S. 2,689,978, Sept. 28. Clamping apparatus for injection molds.

SHEET. J. L. Chynoweth (to Du Pont). U.S. 2,689,982, Sept. 28. Method for avoiding distortion during resin sheet forming.

INSULATION. A. R. McGarvey (to Armstrong Cork). U.S. 2,690,100, Sept. 28. Glass fibers treated with phenolic resin and a phosphate.

INSULATION. A. R. McGarvey (to Armstrong Cork). U.S. 2,690,393, Sept. 28. Fire-resistant phenolic resin.

LAMINATING. J. S. Nelson (to Monsanto). U.S. 2,690,410, Sept. 28. Polyvinyl butyral resin for laminating safety glass.

STRUCTURE. R. B. Seymour (to Atlas Mineral Products). U.S. 2,690,411, Sept. 28. Solid metal structure, a metal mesh bonded thereto, an unsaturated polyester resin thereover, and a furan resin layer.

TUBES. R. J. Nebesar (to Universal Molded Products). U.S. 2,690,412, Sept. 28. Glass-fiber-reinforced plastic tubes.

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WELDING. M. R. Moritz and E. G. Autie (to United Shoe Machinery and Wickham). U.S. 2,690,495, Sept. 28. Seam welding of thermoplastic sheets.

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POLYVINYL CHLORIDE. H. C. Funk and M. B. Reger (to Du Pont). U.S. 2,690,981, Oct. 5. Plasticized polyvinyl chloride.

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COPOLYMERS. P. J. Flory (to Goodyear). U.S. 2,691,006, Oct. 5. Copolymers of two polyesters.

RESINS, W. E. Cass (to General Electric). U.S. 2,691,007, Oct. 5. Unsaturated acidic polyester-ethoxyline resins.

EXTRACTION. J. M. Grim (to Koppers). U.S. 2,691,008, Oct. 5. Extracting low molecular components from polymer particles.

POLYMERS. V. A. Engelhardt (to Du Pont). U.S. 2,691,038, Oct. 5. Polymers of tetrahydrofuran.

FILM. W. C. McVey (to Goodyear). U.S. 2,691,055, Oct. 5. Rubber hydrochloride film.

PLASTICIZING. E. W. Weitzel (to Western Electric). U. S. 2,693,617, Nov. 9. Apparatus for plasticizing and advancing plastic material.

GLASS FIBER WEBS. E. Bay (to Owens-Corning). U. S. 2,693,844, Nov. 9. Method for forming glass fiber webs.

AIRFOIL. J. M. Ellison, R. J. Moore, and R. J. Pease (to Northrop Aircraft). U. S. 2,693,922, Nov. 9. Airfoil leading edge containing polystyrene foam.

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ACRYLONITRILE SOLVENT. G. F. D'Alelio (to Koppers). U. S. 2,694,690, Nov. 16. N,N-dimethyl carbamate ester of a polyhydric alcohol.

INTERPOLYMERS. J. L. Amos, J. L. McCurdy, and O. R. McIntire (to Dow). U. S. 2,694,692, Nov. 16. Linear interpolymers of monovinyl

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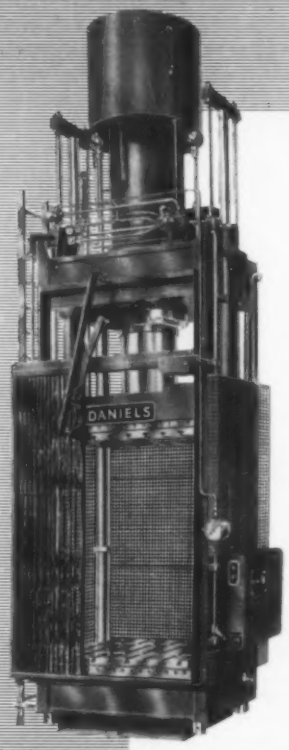

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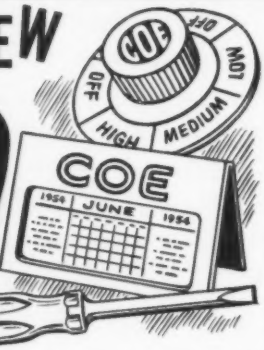

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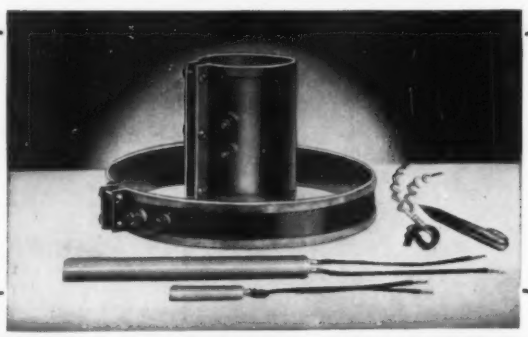

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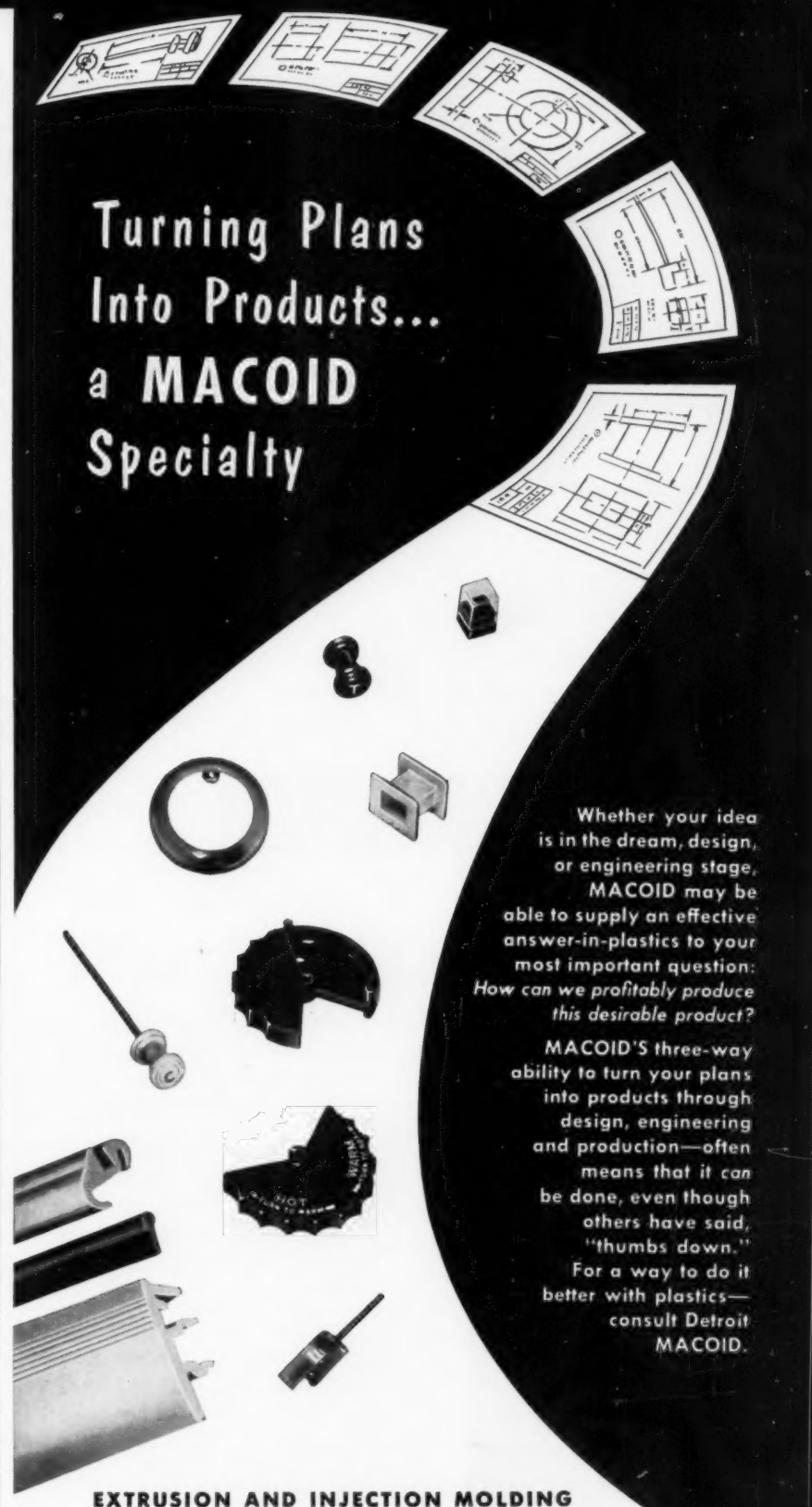
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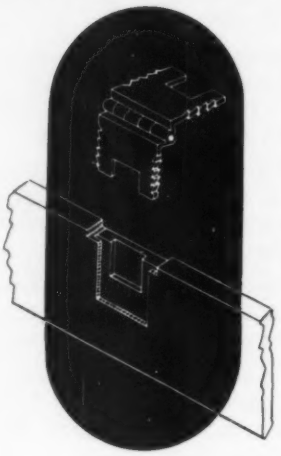

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tricarboxylates as plasticizers for polyvinyl chloride.

FILM STRETCHING. M. O. Longstreth and D. W. Ryan (to Dow). U. S. 2,695,420, Nov. 30. Apparatus for orienting tubular film.

COATING. E. L. Amundson and C. G. Matthews (to Plasti-Clad Metal). U. S. 2,695,421, Nov. 30. Continuous coating of filaments.

CONTAINERS. E. A. Pardee and T. R. Baxter (to Continental Can). U. S. 2,695,423, Nov. 30. Continuous production of containers from plastic sheet.

NYLON. L. L. Stott (to Polymer). U. S. 2,695,425, Nov. 30. Sintered nylon articles.

FOAMED PRODUCT. T. W. Sarge and F. H. Justin (to Dow). U. S. 2,695,-427, Nov. 30. Foaming polyvinylidene chloride resin with radio-frequency heat.

CORRUGATOR. L. J. Segil (to Luminous Ceilings). U. S. 2,695,652, Nov. 30. Corrugating unit for plastic sheet.

EVACUATOR. S. L. Haley, U. S. 2,-695,741, Nov. 30. Air evacuator for plastic bags.

CABLE. G. E. Henning (to Western Electric). U. S. 2,695,769, Nov. 30. Relieving stresses in polyethylene cable sheaths.

POLYMER. G. F. D'Alelio (to Koppers). U. S. 2,695,894, Nov. 30. Reaction product of epoxyalkoxy aryl resin and a drying oil.

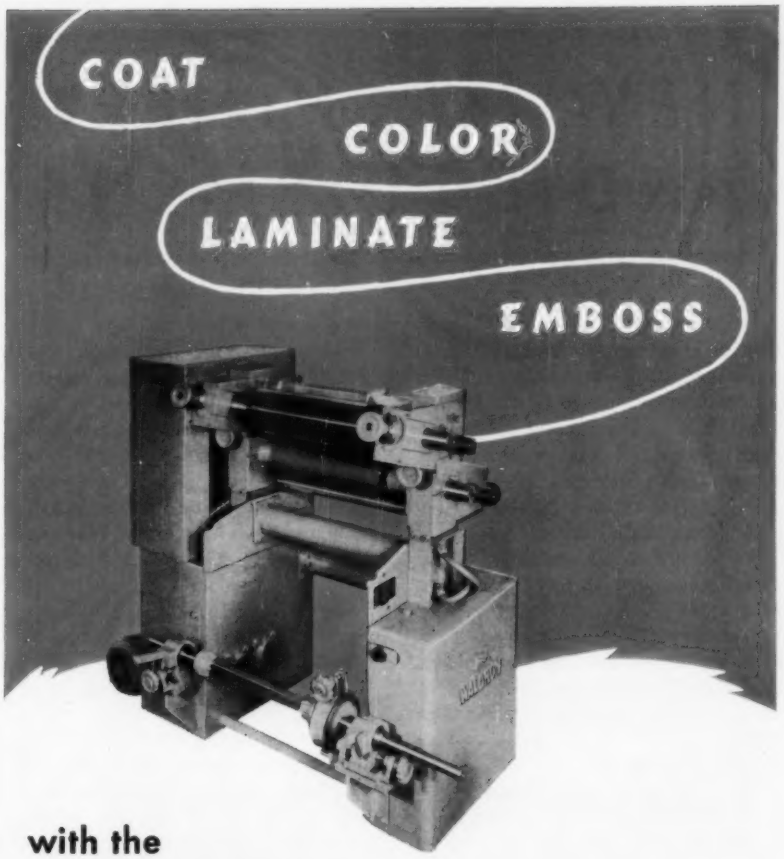
INTERPOLYMERS. H. Ehring and K. Raichle (to Farbenfabriken Bayer). U. S. 2,695,896, Nov. 30. Interpolymers of aromatic vinyl compounds, glyceride oils, and oil-alkyds.

RESINS. M. A. Pollack. U. S. 2,695,-897, Nov. 30. Resin from polyvinyl chloride, tall oil ester, and monohydric phenol.

CHLORINATED POLYETHYLENE. W. Becker and O. Bayer (to Farbenfabriken Bayer). U. S. 2,695,899, Nov. 30. Chlorination of polyethylene.

VINYL COMPOUND. M. Markarian, S. D. Ross, and M. Nazzewski (to Sprague Electric). U. S. 2,695,900, Nov. 30. Trivinyl trichlorobenzene compounds.

POLYAMIDES. H. Wittcoff and M. M. Renfrew (to General Mills). U. S. 2,695,908, Nov. 30. Polyamides.



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No matter what your web of material is, we believe you can coat it, color it, emboss it or laminate it with the Waldron Multi-Coater. The Multi-Coater allows reverse roll coating, reverse smoothing roll coating, knife coating, two-side kiss coating, engraved roll coating, embossing and laminating—all on one precision machine with convenient roll and knife adjustments.

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NEW MACHINERY AND EQUIPMENT

Grinding Equipment—No. 2 centerless grinding machine uses Filmatic bearings—self-adjusting for all conditions imposed by the grinding action, automatically lubricated with filtered oil from a circulating system, and protected with an electrical pressure switch.

A lower side unit, mounted at right angles to the grinding wheel spindle, supports an upper slide unit which carries the regulating or feed wheel.

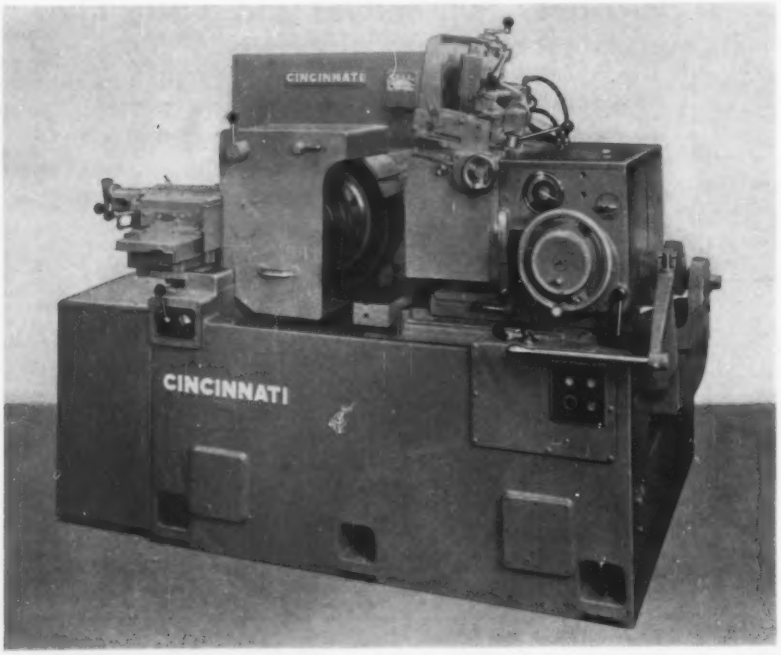
In operation, the upper and lower slides are locked together and glide as a unit over anti-friction ways on the bed; stick-slip is said to be virtually eliminated.

The regulating wheel is driven by a built-in 1½-hp. motor through a wide V-belt. Regulating wheel speeds are infinitely variable within two ranges, from 11 to 320 r.p.m.

Power-operated profile truing is standard equipment for the grinding wheel. Two external controls for changing direction and rate of traverse are located on the operating side of the bed. Included as standard accessories are several types of work rest, long bar grinding attachments, automatic electro-hydraulic and roto-infeed attachments, automatic and hand grinding wheel spindle, hoppers, and others. *Cincinnati Grinders, Inc., Cincinnati 9, Ohio.*

Engraving Machine—Heavy duty pantograph engraving machine is specifically designed for the engraving of large pieces. It operates by tracing master copy with a stylus.

The unit is for use in engraving panels, name plates, dials, scales, instruments, etc., and works on plastics, metals, wood, etc. An infinite number of reduction ratios from master copy, starting at 2 to 1, are said to be available. A single handwheel adjusts both master copy and cutting tool vertically in 0.001-in. increments. Engravings can be performed up to the center of a 30-in. panel, or 15-in. from the outer edge of a panel of any size. Circles up to 7 in. in diameter may be engraved at the 2 to 1 ratio. *The Green Instrument Co., 385 Putnam Ave., Cambridge, Mass.*



Cincinnati Grinder's No. 2 centerless grinding machine has self-adjusting bearings

Injection Accessory—Designed to solve the problems of mold packing and hence of shot variation, the Packomatic Compensator is reported to maintain a hydraulic pressure balance at the gate after a predetermined amount of packing has taken place.

The unit operates as follows: Injection pressure is maintained at the optimum value for a predetermined period after the mold has been filled to allow for optimum packing. This is achieved by the setting of stop nuts on a special pressure-reducing valve. Pressure is then reduced at a given rate, this rate coinciding with the drop in cavity pressure; rate of fall of injection pressure is governed by the adjustment of a small restrictor. Finally, if required, a constant minimum sustaining pressure is maintained to prevent further outflow from the cavity; this too is accomplished by setting of the stop nuts.

Dimensions of the unit are 20¼ in. long, 10¼ in. deep, and 5⅜ in. high. *Peco Machinery Sales (Westminster) Ltd., 28 Victoria St., London S. W. 1, England.*

Sheet Lifter—For lifting objects having flat surfaces, particularly sheet, the pistol-grip-equipped Press-Vac Lifter has a suction cup that will pull 11 p.s.i. This constant lifting power is produced by passing compressed air (45 p.s.i.) through a venturi built into the instrument, creating a constant vacuum of 22 in. of mercury.

The unit is supplied with a 5-in. Neoprene cup, aluminum handle, 96-in. hose, and a pressure regulator which reduces line pressure to 45 p.s.i. *F. J. Littell Machine Co., Air Div., 4555 Ravenswood Ave., Chicago 40, Ill.*

Control Equipment—Type 230-A Recorder is a 30-channel instrument that gives an instantaneous and permanent record of the operation, cycle, and down-time of up to 30 separate machines. The record is produced in the following manner:

MODEL
H-250

NEW!

VAN DORN
2½ Oz. Automatic Press

Check these outstanding features of this ultra-modern Van Dorn injection press:—

GREATER CAPACITY— Up to 2½ oz.; smaller pieces at faster cycles.

HI-SPEED PERFORMANCE— Plasticizes material at 22 lbs. plus per hour.

FASTER PRODUCTION—Will attain up to 720 cycles per hour (dry run).

HIGHEST EFFICIENCY—Due to water cooling of injection plunger, transfer hopper and oil cooler.

ACCESSIBILITY— Due to simple platen clamp device for purging to change material or color.

MORE SAFETY— Mold hydraulic mechanism makes press non-operative unless molded part is completely ejected.

SIMPLER OPERATION—Due to automatic, adjustable material metering device.

MULTIPLE OPERATIONS—Minimum operator attention by use of larger hopper and light that indicates when press needs attention.

SELECTIVE CONTROL—Merely throw toggle switch to operate press semi-automatically.

DEPENDABILITY— Because of all-steel construction and Van Dorn's established reputation in the plastics machinery field.

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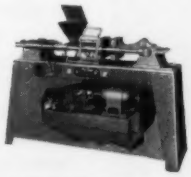
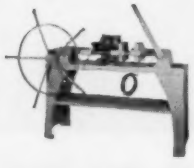
and this Van Dorn model is the lowest priced press in its class!

WRITE FOR COMPLETE DATA ON MODEL H-250 AND OTHER EQUIPMENT SHOWN

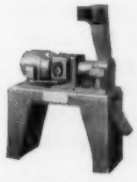
SEMI-AUTOMATIC PRESS
2-oz. capacity.



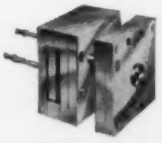
POWER OPERATED, LEVER CONTROLLED PRESSES
2-oz. and 1-oz. models



MANUALLY OPERATED PRESS
1-oz. For small jobs, training, etc.



PLASTIC GRINDER
Grinds up rejects, waste, etc., for re-use.



MOLD BASES
Available from stock.

Alden's recorder provides continuous and permanent record of machine operation

The unit is connected to the equipment to be monitored by tiny switches placed on the equipment. The switches are activated by motions of the machine, i.e., a current flows through them when the equipment is operative. This current is fed through styli mounted in the recorder (one for each machine monitored) which are in constant contact with a tape of electro-sensitive paper being fed at a constant rate. As long as electricity flows, each stylus leaves a continuous mark on the paper; no mark is made in the absence of current flow. Paper feed is usually driven by synchronous motor to provide a time base.

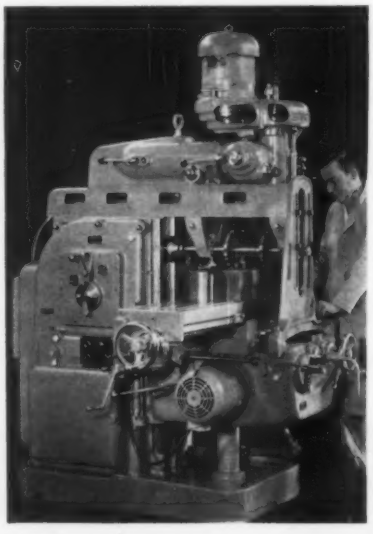
Two models are available. Model 230A-6 has a tape speed of 1 and 6 in./min., and Model 230A-12 with a 1- and 12-in./min. tape speed. *Alden Electronic and Impulse Recording Equipment Co., Westboro, Mass.*

Milling Machine—Horizontal-vertical-universal milling machines incorporate a "receptor ram" in place of the conventional overarm. This ram accommodates arbor supports and arbor support brace for slab or straddle milling (see accompanying photo). For face milling, the arbor supports and brace are removed together with the arbor, and the receptor ram is moved to rear until its front end is flush with the column face.

The horizontal spindle has a speed range from 25 to 200 r.p.m.; by installing a heavy duty vertical attachment on the machine parking bracket, roughing cuts can be made with the same speed ranges. For finishing, the vertical attachment is swung aside and the universal head and ram assembly is moved into position. Spindle has a vertical feed of 3½ in. and is operated either by a hand feed lever or worm and worm wheel micrometer feed crank.

The universal head can be swiveled left, right, front, and back 45°, 45°, 45°, and 30°, respectively. It is positioned by hand levers through worms and worm wheels.

A tracer head and duplicator table can be installed for manual duplicating. *George Gorton Machine Co., 1321 Racine St., Racine, Wis.*



George Gorton Machine's milling unit, with arbor supports in place, has receptor ram with universal head and ram assembly

Heat Sealers—For applications where production-type sealing equipment is uneconomical, hand-held units can be used for end sealing and lap sealing thermoplastic and cellophane bags and packages with flat or irregular shapes.

The unit weighs less than 1 lb. and operates from either a.c. or d.c. sources. Temperature is adjustable from 200 to 450° F.; heating element consumes 50 watts. When not in use, rollers of instrument are kept off table by a safety rest.

Three models are available. Model 50, for sealing polyethylene, Pliofilm, and other thermoplastics; Model 51, for sealing cellophane; Model 52, for sealing and cutting polyethylene, etc. *Sealine Mfg. Corp., 4716 W. Lake St., Chicago 44, Ill.*

Automatic Molding—Low-pressure mold closing attachment is claimed to assure positive mold protection in fully automatic operation of Model 175T-4 6-oz. injection molding machine. With the attachment installed, it is reported to be possible to operate a battery of these units on an automatic basis with one attendant.

Model 175T-4/6 is designed for rapid molding (600 cycles/hr. dry run) of small thermoplastic parts, and was described in detail in Modern Plastics, *31*, 152 (March 1954). *Reed-Prentice Corp., Worcester, Mass.*

Marking Equipment—Two models have been added to a line of roll leaf stamping presses: Model A (hand operated) and Model AA (air operated). Both are high-speed presses for marking plastics, cloth, paper, leather, wood, etc., and are said to be especially suitable for use on irregularly shaped objects. Both presses have adjustable roll feed, accommodating leaf up to 6½ in. wide, and will feed up to 5¾ in. of leaf in ⅛-in. graduations. Side to side feed is standard, but front to back feed is available. A stamping pressure spring, adjustable from zero to solid, is located in the machine head for resetting of identical pressures. Automatic heat control

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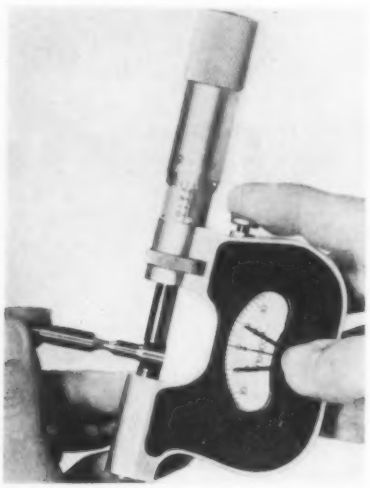
and separate indicating thermometers are provided. Model A can be converted to air operation by addition of an air pressure cylinder and controls. Maximum speed for Model AA is 40 impressions per minute. *The Peerless Roll Leaf Co., Inc., 4511 New York Ave., Union City, N. J.*

Measuring Instrument—Master Compar indicating micrometer has a range from 0 to 1 in., reading in 0.0001-in. increments. The indicating mechanism controls the measuring pressure, eliminating uncertainties due to differences in "feel" by individuals. The unit, combining the



George Scherr's Master Compar is a combination micrometer-comparator with zero to 1-in. range in 0.0001-in. increments

functions of a micrometer and comparator, provides a complete set of Go and No-Go gages of 1-in. range, reading in 0.0001-in. increments. The instrument detects out-of-roundness, ovalness, and taper. A release button for the movable anvil is on the right hand side of the tool. Other models in ranges up to 4 in. are also available. *George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y.*

Portable Hardness Tester—Usable as a bench instrument or as portable equipment, this Brinell hardness tester applies a load of 3000 kg. to a 10-mm. ball, which in turn leaves a clear impression on the test specimen. The size and type of the impression indicates the degree of hardness.

The unit has threaded posts on which the test head can be moved up and down by means of a crank handle. This allows the machine to be operated on a range of different size parts, up to 10 in. high. The test head is removable, allowing testing parts of any size, provided, of course, that the test head can be held by some means capable of withstanding the 3-ton thrust of the ram on the ball (e.g. C-clamps, yokes and tie bars, jacks and beams, etc.). The instrument will also apply loads of 500, 750, 1000, and 1500 kilograms. *Andrew King, 67 E. Lancaster Ave., Ardmore, Pa.*

Mixing Unit—Horizontal-type ribbon mixer, designed for rapid blending of wet or dry materials, is available in sizes for working volumes from ¼ to 175 cu. feet.

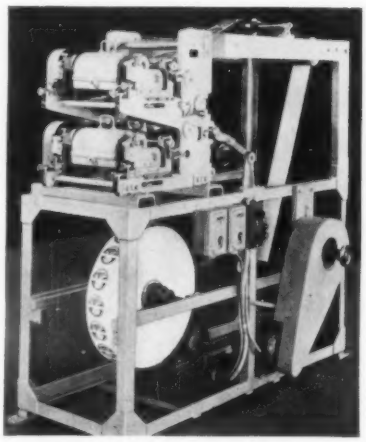
The ribbon shaft is flange coupled within the tub to facilitate removal. Drive is said to be drip-proof. Gear reducer and chain drive are mounted on an integral base. The unit is equipped with either center or end discharge valve. *The Stevenson Co., 225 N. Wilkinson St., Dayton, Ohio.*

Splitting Equipment—Materials that can be handled by two new splitters include many synthetics, latex and bonded foam, rubberized hair, cellulose sponge, cork, resin-bonded fiber, wood fiber, and fibrous glass. The splitters accommodate stock in rolls, sheets, and slabs. Two models are available—Model 65, which splits stock up to 65 in. wide, and Model 75, which splits stock up to 75 in. wide. Depending on the materials, the machine is claimed to produce splits as small as 1/16 in. thick. *Falls Engineering and Machine Co., Cuyahoga Falls, Ohio.*

Extruder—Series 232-25 is a hydraulic extrusion press with two material cylinders for simultaneous loading and extrusion, said to allow almost continuous extrusion. The presses can be converted from horizontal to vertical extrusion, and include a built-in hydraulic pumping system. A vacuum sealing arrangement used with the removable material cylinder automatically pushes the cylinder into a sealed position at both ends when the hydraulic ram moves forward. On the return stroke, it automatically breaks the vacuum seal, disengaging the cylinder so that it can be lifted out to be replaced with a loaded cylinder. Die and nozzle are said to be easily removed from the head. A vacuum de-airing valve is claimed to prevent material from entering the vacuum lines. *Loomis Engineering & Mfg. Co., 126 S. 14th St., Newark 7, N. J.*

Flexographic Press—Designated APS-Junior, flexographic press for roll-to-roll printing of narrow webs occupies a floor area of 10 sq. ft.; it can produce multi-color printing on webs at claimed speeds of up to 300 ft./min. for film. It has a maximum printing repeat of 15¾ inches.

The press is recommended for printing all flexible materials, including polyethylene, cellophane, foil, tissue, kraft paper, cup stock, and boxboard. It is available in 2-,



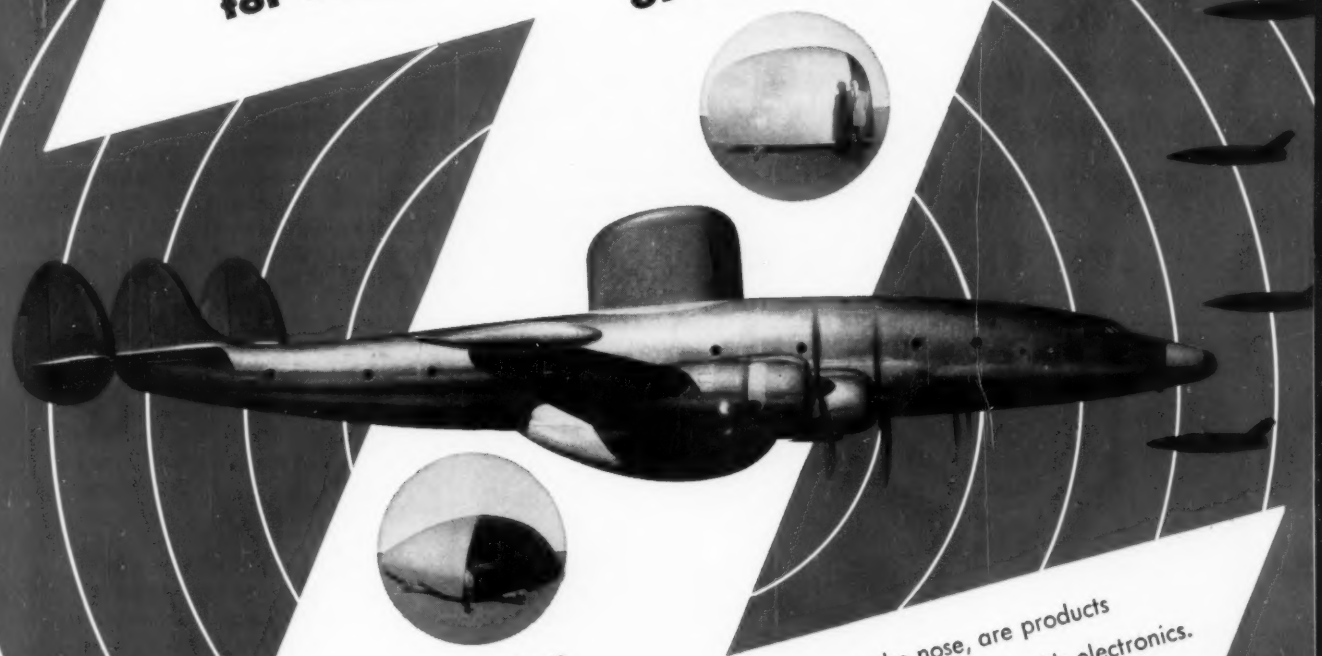
Manhasset Machine's flexographic press produces multi-color printing on webs of film at speeds up to 300 ft. per minute

3-, and 4-color models with printing widths from 4 to 12 inches; and is furnished complete and ready-to-run with rewind, perforating unit, and motor. The machine is stated to be designed so as to be adaptable for feeding a slitting unit. *Manhasset Machine Co., Mineola, N. Y.*

Mold Bases—Several modifications have been incorporated into a standard line of mold bases; they include the following:

Clamping ledges on the 12-, 15-, and 18-in. series of standard mold bases have been replaced with clamping slots. In addition to removing the space-wasting clamping edges, this modification reduces the widths of these sizes to 11⅞, 14⅞,

ZENITH skill produces world's largest radomes for Lockheed "Sentinels of the Air"



The huge radomes above and below the Lockheed Super-Constellation, and the novel anti-icing radome in the nose, are products of Zenith's specialized technique and skill in reinforced plastics combined with electronics. These are the giant radomes which provide 360-degree "eyes and ears" for the U. S. Navy and Air Force, scouting far beyond the borders of the United States for early warning of enemy attack.

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MOLDING PRESSES
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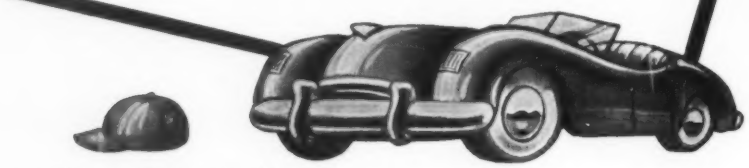

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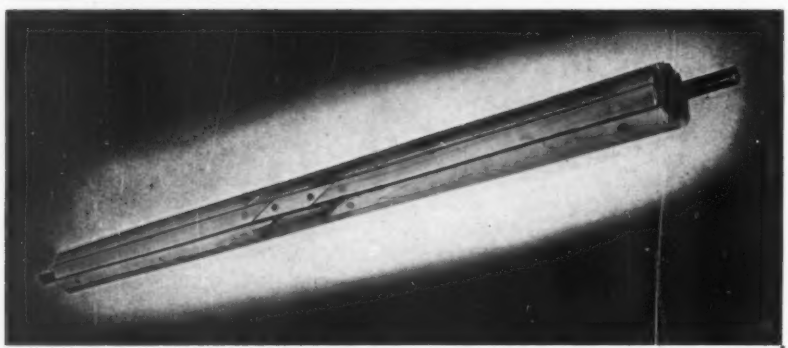

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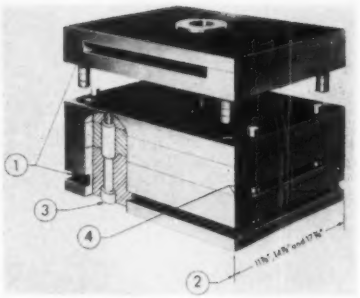

Detroit Mold's redesigned mold base has 1) clamp slots, 2) reduced widths, 3) increased water line space, 4) welded stop pins

and 17⅞ in., respectively, making it possible to install them in many additional injection machines with no sacrifice in cavity area.

Tubular dowel construction, by super-imposing the dowel pin locations over the cap screws, is said to allow more room for waterlines.

Ejector housing is now constructed of one piece to reduce the number of components and give added rigidity to the mold base. *Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich.*

Laminating Press—Model 154 letter-size laminating press is intended for the lamination of cards, photographs, clippings, documents, etc., and is available for 8- by 10- and 9- by 12-in. laminations. It has a claimed production capacity of 150 full-size, or 1200 wallet-size laminations per 8-hr. day.

The press is equipped with a self-contained, hand-operated hydraulic unit, with a maximum load pressure of 40,000 p.s.i. A two-opening design incorporates thermostatically controlled hot plates for temperatures up to 400° F. and separate multi-channel water cooling plates, is said to provide for simultaneous heating and cooling of laminations. Built-in pressure, temperature, and timing controls are provided. Size of the press is 19 in. wide, 19 in. long, and 36 in. high. Unboxed weight is 375 pounds. *Fred S. Carver, Inc., 1 Chatham Rd., Summit, N. J.*

Automatic Deflasher—Designed to automatically remove parting line flash from flat rectangular plastics objects at a reported rate of 30 to 65 pieces per min., a new machine is said to accommodate parts from 2½ to 4¾ in. wide by 4¾ in. long. Feed

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- ODP (Iso-Octyl Iso-Decyl Phthalate)
- O-16 (Iso-Octyl Palmitate)
- TG-8 (Triethylene Glycol Dicaprylate)
- TG-9 (Triethylene Glycol Dipelargonate)
- DOP (Di-2 Ethylhexyl Phthalate)
- DOA (Di-2 Ethylhexyl Adipate)
- DIOA (Di-Iso-Octyl Adipate)
- DOS (Di-2 Ethylhexyl Sebacate)
- DIOS (Di-Iso-Octyl Sebacate)
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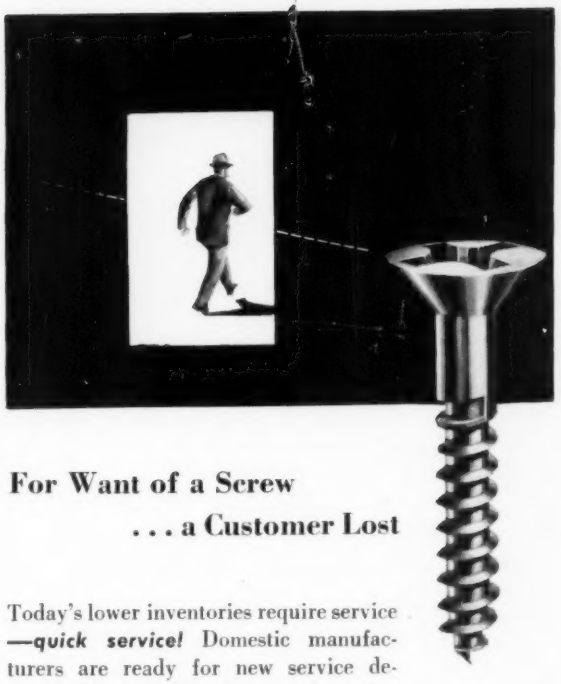

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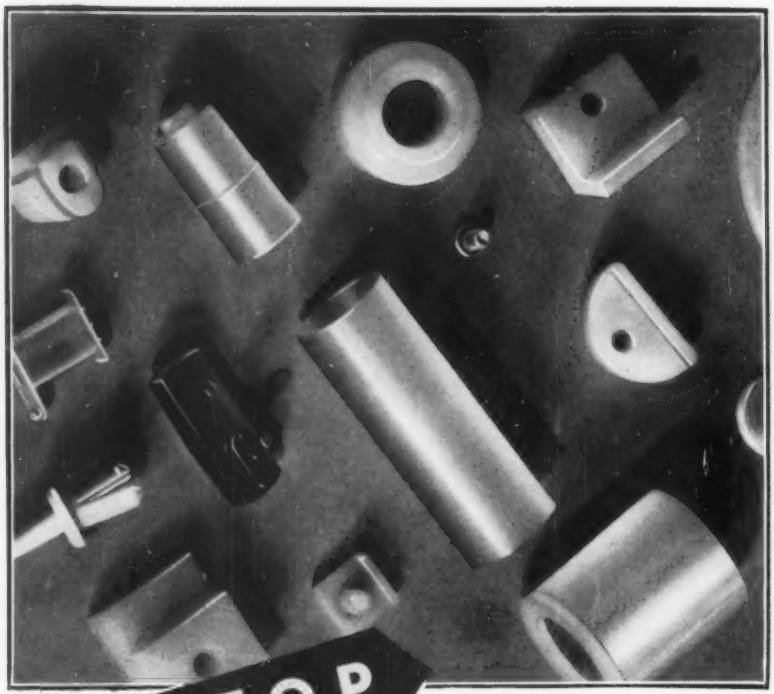

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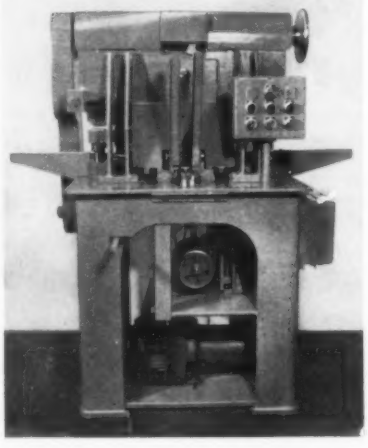

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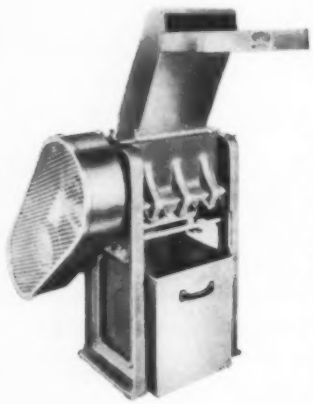

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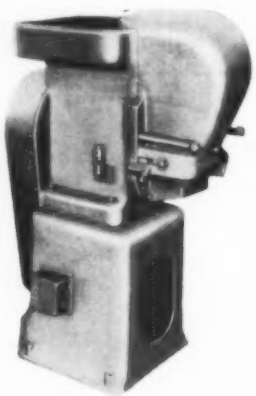

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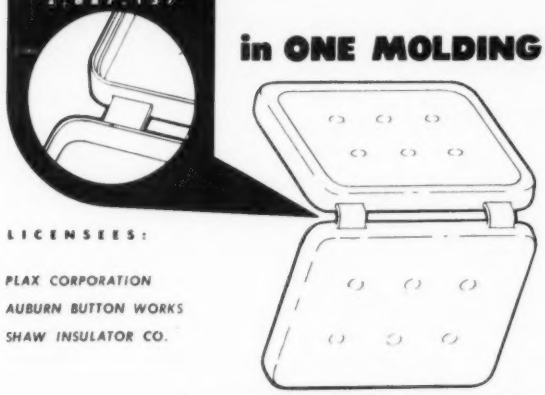

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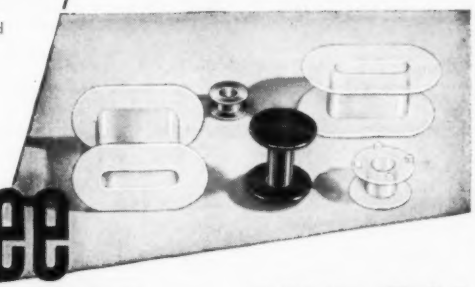

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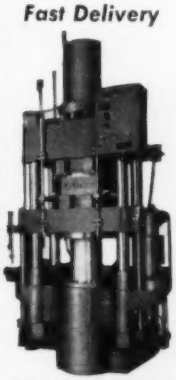

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BOOKS AND BOOKLETS

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"Deterioration of Materials," edited by Glenn A. Greathouse and Carl J. Wessel

Published in 1954 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 835 pages. Price: $12.00.

The result of a collaborative effort between the Services Technical Committee of the U. S. Dept. of Defense and the National Research Council of the National Academy of Sciences, this compendium analyzes the several causes of material deterioration and suggests means for prevention. The text covers climatic, chemical, physical, and biological agents of deterioration as related to plastics, metals, woods, textiles, and other materials, and indicates methods of preserving these materials; some assembled units (e.g. electronic and optical equipment) and their preservations are discussed; and some special aspects of preservation (dehumidification, packaging, and preservatives) are investigated. An appendix on Government specification numbers is included.

"Manual on Industrial Water," 2nd Printing

Published in 1954 by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

This manual offers a broad discussion on the nature and uses of industrial water as well as test methods and specifications. The general discussion is essentially the same as that appearing in the first printing (1953), but 11 new test methods, eight revisions of existing methods, and a detailed index have been incorporated.

"Mechanisms of Polymer Reactions," by G. M. Burnett

Published in 1954 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 493 pages. Price: $11.00.

The third volume in a series of monographs on the chemistry, physics, and technology of high polymers presents a highly technical account of the present state of knowledge of high polymer science, with strong emphasis on the general kinetics involved in radical polymerization and with an unusually detailed mathematical treatment.

Maleic anhydride—Chemical and physical property data on maleic anhydride, plus a brief explanation of the formation of the various types of resins which it produces, are presented in this 20-page booklet. Use of the chemical in phthalic-type alkyd resins, in the upgrading of drying oils, and in the formation of hard resins and tall oil resins is described; step-by-step instructions for the preparation of typical formulations are given. Diels-Alder reactions of maleic anhydride as well as other organic chemical syntheses are discussed. *Monsanto Chemical Co., Organic Chemicals Div., St. Louis 4, Mo.*

Wire insulation—Technical literature on Pliovic EDB90V, a polyvinyl chloride resin formulated for wire insulation, lists typical electrical and physical properties. Said to be suitable for all electrical uses where vinyls are applicable, Pliovic EDB90V can be used in Underwriters' approved wire insulation compounds where interchangeable resins are allowed, in primary insulations for building and industrial wires, in cable jacketing, and in flexible cord. *The Goodyear Tire & Rubber Co., Chemical Div., Akron 16, Ohio.*

Temperature control—An indicating temperature controller (Series 560), using a thermistor as the sensing element, is described in this pamphlet. Performance specifications and design features are listed. *Fenwal, Inc., Ashland, Mass.*

Magnetic separators—Catalog 17 provides information on installations, technical data, specifications, and sizes of a line of magnetic separators for the in-process removal of unwanted iron. *Eriez Mfg. Co., Erie, Pa.*

Cutting equipment—Specifications and dimensions of a complete line of shears are presented in Brochure C-54. Safety control arrangements for one- and two-man operation are suggested. *Merrit Solem, Div. of Solem Machine Co., 118 S. Niagara St., Lockport, N. Y.*

Mold finishing—Application of the wet blasting process in die and mold finishing, using the Liquamatte machine, is described in four-page Bulletin 113. Performance data are presented. *American Wheelabrator & Equipment Corp., 1254 S. Byrkit St., Mishawaka, Ind.*

Packaging—"How to Pack It" describes a selection of 12 different styles and more than 70 types of corrugated boxes for a variety of products. Proper methods of sealing, packing, and displaying are also discussed. *Hinde & Dauch, Sandusky, Ohio.*

Temperature control—Various mold temperature control techniques, together with the equipment which their application entails, are presented in "Temperature Control Reference Manual, Plastics Industry." Also included in the manual are numerous catalog sheets covering various temperature, pressure, and humidity control systems and accessories. *The Powers Regulator Co., Skokie, Ill.*

Phthalic anhydride—Information on the major established uses of phthalic anhydride is summarized in this 24-page booklet. The material finds use in the manufacture of alkyd and polyester resins, phthalate plasticizers, dyes, pharmaceuticals, and other complex organic compounds. Data on characteristics and handling methods are also presented. *Monsanto Chemical Co., St. Louis 4, Mo.*

Plastics in Europe—Two volumes of monographs present a series of lectures on chemical equipment. Volume 22 contains six papers on the development of chemical apparatus and equipment (delivered at the 26th Congrès International de Chimie Industrielle); volume 23 presents eight

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papers on chemical engineering and equipment construction delivered by Kirschbaum students at the Fridericiana Technical University at Karlsruhe. In German. Vol. 22 contains English and French summaries. Price to non-members of Dechema: vol. 22—DM 25.90 (ca. $6.00); vol. 23—DM 17 (ca. $4.25). Dechema, Postfach, Frankfurt am Main-W., Germany.

Metallic soap—Physical and chemical properties as well as uses of metallic stearates are discussed in this 26-page booklet. Also described are the products of a company long active in that field. *Synthetics Products Co., 1636 Wayside Rd., Cleveland 12, Ohio.*

Fork trucks—How small and medium-size plants can compete with big companies in materials handling efficiency is covered in a 28-page booklet entitled "Why the Small Fork Truck?" The booklet analyzes the space, time, and labor factors involved in small plant operations and presents fundamental solutions to materials handling problems peculiar to small-scale operations. Plans and diagrams for setting up efficient materials handling systems in present locations or in new plants are given. *Market Forge Co., Materials Handling Div., Everett 49, Mass.*

Catalysis—The phenomena of group selectivity and step selectivity in catalytic reactions (especially catalytic hydrogenation) are succinctly discussed in this four-page folder. Special stress is placed on the use of platinum metals as catalytic agents. Included is a survey of recent U. S. patents dealing with selective hydrogenation with platinum metal catalysts. *Baker & Co., Inc., 113 Astor St., Newark 5, N. J.*

Motors and valves—Bulletin SP-50 lists dimensions and specifications of a line of air motors and valves. Included are foot-mounted, pivot-mounted, flange-mounted, and remote-controlled motors and a variety of valves. Dimensional drawings are given for each model. *The Bellows Co., Akron 9, Ohio.*

Cooling equipment—Several types of cooling cylinders for use on calenders, embossers, batchers, and similar equipment, are described in this four-page folder. The units use water at available line temperatures as the cooling medium; and, because it is distributed by gravity, complicated piping, rotating joints, and sealed-in chambers are eliminated. Dimensions and schematic drawings are given. *J. E. Carroll & Co., 110 Cambridge St., Lowell, Mass.*

Steam trap—Bulletin 255A describes a series of steam traps that use the kinetic energy of steam to close the valve. The only moving part of the unit is the valve head; and the same head and seat are used for pressures to 600 p.s.i. and temperatures to 950° F. The bulletin gives dimensions, prices, and engineering drawings. *Sarco Co., Inc., Empire State Bldg., New York 1, N. Y.*

Mold making—How and when to use beryllium copper mold components is discussed in a 50-page brochure entitled "The 'True-Cast' Handbook." The brochure describes the characteristics of beryllium copper; product applications of mold components made from it; how a cast beryllium copper mold is made, finished, and heat-treated; how it compares with hobbed components; and how it can be ordered. A glossary of terms is appended. $2.00. *Manco Products, Inc., 2401 Schaefer Rd., Melvindale, Mich.*

Halogenated hydrocarbon—Physical and chemical properties and various reactions of 1,2-dichloroethylene (mixed cis and trans isomers) are covered in this technical data report. Suggested uses for this material include refrigeration liquid, solvent for fats and oils, extraction of caffeine from coffee, dehydration or concentration of propionic acid from its aqueous solution, separation of ortho and para isomers of various phenols, pretreatment in dyeing of cellulose esters and ethers, and others. A section on toxicity and handling is included. *Monsanto Chemical Co., Plastics Div., Springfield, Mass.*

Catalog of plastics—Information on properties and uses of more than 50 plastics and resins—including vinyl, phenolic, polystyrene, polyethylene, fluorothene, polyester, silicone, and epoxy—is summarized in this revised 12-page reference file. The information is presented in classified form under such headings as molding materials, extrusion materials, bonding resins, calendering materials, flexible film and sheeting, plastic rigid sheets, laminating plastics, and others. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y.*

Processing equipment—Operating characteristics and a description of automatic processing equipment for foamed and unfoamed polyurethanes and other multi-component resins are contained in this 8-page booklet. The equipment is claimed to produce foamed polyurethane under rigidly controlled conditions. The functions automatically performed by the equipment are de-aeration, proportional metering, homogeneous mixing, and metered dispensing at predetermined rates. *Applied Engineering Associates, 1952 Flushing Ave., Brooklyn 37, N. Y.*

Plastic pipe—Bulletin 80-A lists technical data on a general-purpose, corrosion-resistant, multi-polymer rigid pipe claimed to have exceptional impact strength. Information is presented on properties, chemical resistance, standard sizes, pressures, and prices. Installation and fabrication instructions are also included. *American Hard Rubber Co., 93 Worth St., New York 13, N. Y.*

Protective coatings—Characteristics, typical uses, and application information on a series of protective coatings are presented in this 12-page booklet. Included are coatings based on vinyl copolymer resins, acrylic resins, synthetic rubber, epoxy resins, rubber base-styrene butadiene copolymer resins, and modified silicone resin. Price list is included. *David E. Long Corp., 220 E. 42nd St., New York 17, N. Y.*

Rare chemicals—Almost 300 special chemical compounds, from acid pyro-phosphoric to zirconium oxychloride, available from stock in drum-, barrel-, carboy-, and jar-lots, are enumerated in this four-page folder. *City Chemical Corp., 132 W. 22nd St., New York 11, N. Y.*

Finishing—Two technical bulletins discuss several applications of pressure-blast finishing operations. Bulletin 3 deals with deburring, Bulletin 4 with finishing and cleaning prior to electroplating. Such factors

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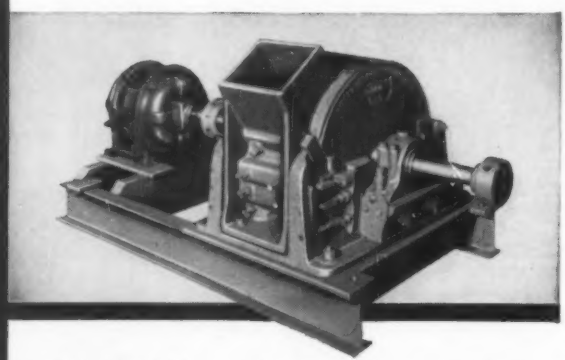

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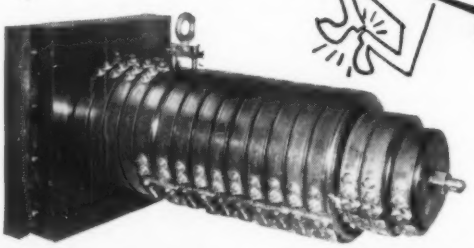

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as size of abrasive, rate of motion of the abrasive stream, and masking effect of water carrier are covered. *The Cro-Plate Co., Inc., 747 Windsor St., Hartford 1, Conn.*

Printed circuitry—Basic technical information and design data related to applied printed circuitry are outlined in this 12-page bulletin and the economics of printed circuit design and construction are compared with conventional hand-wiring methods. Specifications on and properties of a line of copper-clad laminates for use in printed circuitry are also listed. *National Vulcanized Fibre Co., Wilmington 99, Del.*

Electronic terms—Over 3500 terms used in industrial electronics, radio, and television are defined in "A Dictionary of Electronic Terms." 25¢. *Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.*

Plastics publicity—Three brochures, produced in conjunction with a series of film strips dealing with various aspects of plastics, present information on the uses and properties of all major plastics materials in nontechnical language. The three brochures are entitled "Plastics is Your Business" (addressed to the consumer and the business and professional man), "Plastics in Your Home" (indicating where plastics are best used in today's homes), and "Talking Plastics" (addressed to high-school audiences and their interests). These brochures are available in quantity lots. For price information contact *The Society of the Plastics Industry, Inc., 67 W. 44th St., New York 36, N. Y.*

Plastics for packaging—Booklet G-21 presents a summary of the uses of plastics in consumer and industrial packaging, covering polyethylene, phenolic, styrene, copolymer, and vinyl. Properties and advantages of each type of plastic are described, together with details on color and finish possibilities. *Bakelite Co., a Div. of Union Carbide & Carbon Corp., 300 Madison Ave., New York 17, N. Y.*

Packaging directory—Intended as a reference guide for purchasing agents, factory superintendents, and others interested in packaging equipment, "Directory of Packaging Machinery" is divided into three sections. One section lists tradenames of equipment and names of manufacturers; the second lists type of equipment and names of manufacturers; and the third lists machinery makers alphabetically with information on the machines each one makes. $10.00. *Packaging Machinery Manufacturers Institute, 342 Madison Ave., New York 17, N. Y.*

Reinforced plastics—"Methods for Molding Reinforced Plastics" gives detailed descriptions and in-process photographs of various techniques used in the production of a reinforced plastics car body (matched metal molding, pressure bag molding, vacuum bag molding, and hand lay-up). Also included in the 24-page brochure is a summary of chemical and physical properties of Vibrin 151 polyester, as well as a list of raw material and equipment suppliers. *U. S. Rubber Co., Naugatuck Chemical Div., Naugatuck, Conn.*

Mold bases—Catalog lists complete line of mold bases, retainer sets and plates, ejector housings, leader pins, core pins, injector pin counterbores, hand grinders, bristle polishing brushes, midget end mills, carbide cutters, and abrasive-mounted points. Information on mold design standards is also presented. *Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich.*

Heater—File folder contains technical data on sprayed-on and film-type electrical heating elements for applications where odd contour shapes, space and weight limitations, and lagging, make use of conventional heating elements problematic. *Electrofilm, Inc., P. O. Box 106, N. Hollywood, Calif.*

Epoxies—Reference folder on the properties and applications of a line of epoxy resins covers heat-setting and cold-setting liquid resins for casting, laminating, and coating. Appropriate accelerators are indicated. *Marblette Corp 37-21 30th St., Long Island City 1, N. Y.*

Closures—Combination catalog and blank price list on stock and custom-molded plastic closures permits the prospective purchaser to indicate in the catalog his choice of material,

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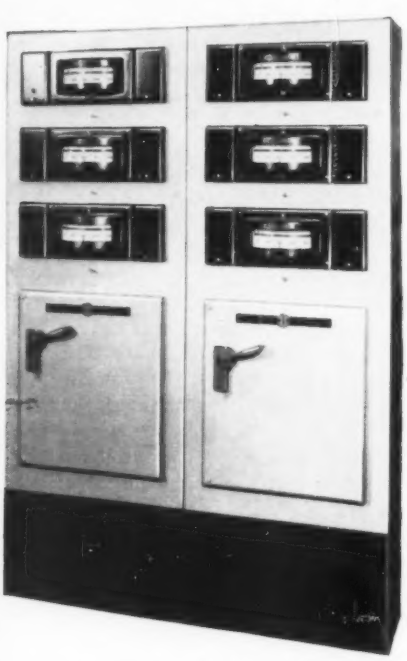

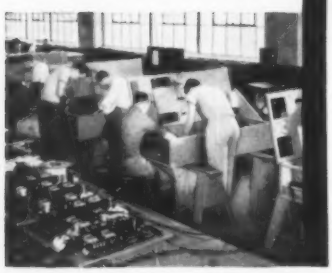

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color, liner, and quantity, send it to the company, and have it returned to him, with prices inserted, as a quotation. *Colt's Mfg. Co., Plastics Div., Hartford 15, Conn.*

Chemical industry—Product flow charts of the organic and inorganic chemical industries in the U. S. are presented in "Chemical Economics Handbook." The charts trace each raw material through intermediates to end-chemicals and end-uses. Also included are notes which outline the criteria on the basis of which the flow charts were developed. $5.00. *Stanford Research Institute, Stanford, Calif.*

Dielectric heating—Bulletin 15B6431B describes a line of dielectric heaters and discusses their operating advantages in heating, drying, baking, or curing of non-conductive materials. Units offered range in size from 3 kw. for laboratory and research projects, and certain production jobs, such as heating plastics preforms, to 60-kw. heaters for setting glue joints, heat forming of parts, curing, etc. Also listed are 15- to 50-kw. heaters for use with continuous conveyor-type ovens handling large quantities of sand cores and similar items. *Allis-Chalmers Mfg. Co. 1163 S. 70th St., Milwaukee, Wis.*

Injection molding supplies—Catalog lists replacement nozzles, replacement cylinders, feeders, hoists, grinders, drying and annealing equipment, tumblers, temperature controls, hydraulic oil accessories, and miscellaneous plant accessories. Where necessary, engineering drawing of components are given. Price and ordering information is included. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Engraver—Model D-2 heavy-duty pantograph engraver is described in this four-page folder. The unit is open on three sides and equipped with a single vertical adjustment for both spindle and copy table. *Green Instrument Co., 386 Putnam Ave., Cambridge, Mass.*

Mulling equipment—Bulletin 522 discusses the principles of mulling and describes the application and use of the Mix-Muller for dispersal of pigments and plasticizers in the preparation of plastics for calender-

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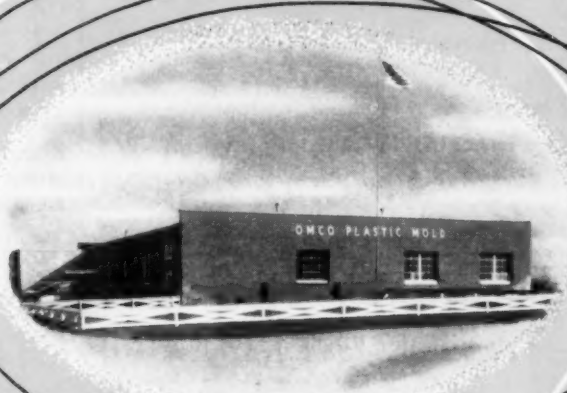

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- **Prevents slipping or tearing out of plastic being formed**
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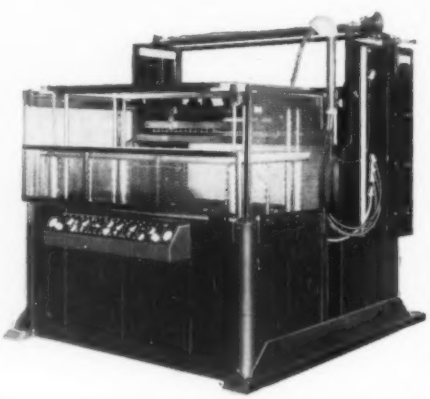

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ing and extruding. *National Engineering Co., Simpson Mix-Muller Div., 665 Machinery Hall, Chicago 7, Ill.*

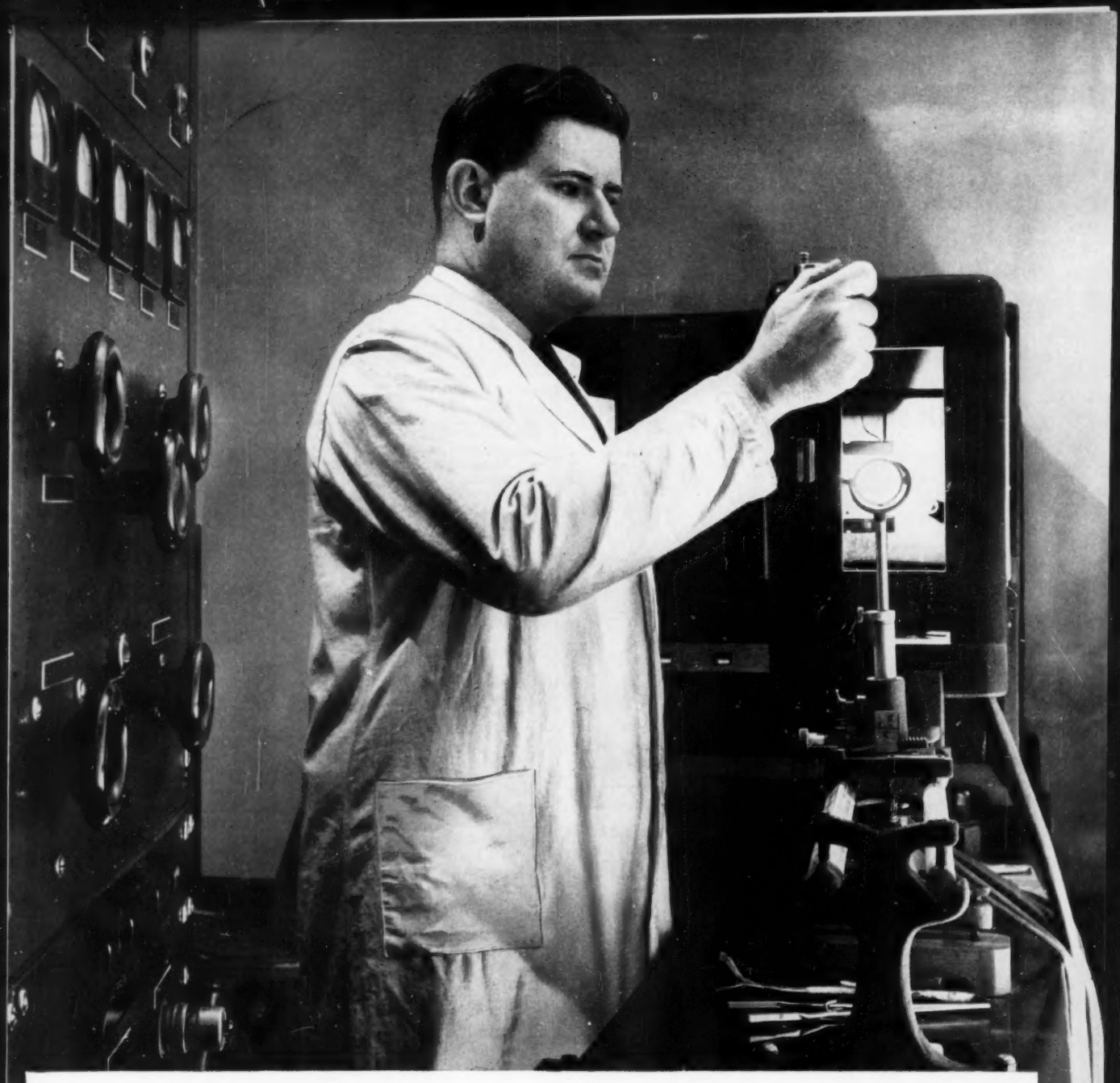
Grinding — This handbook presents an over-all discussion of ball and pebble mill operation. Chapters on types of mills and principles of grinding discuss in detail such topics as speed of mill, quantity of grinding media, type of grinding media, size of grinding media, quantity of material, consistency of material in wet grinding, materials in dry grinding, size of mill, etc. $1.00. *Paul O. Abbe, Inc., 257 Center St., Little Falls, N. J.*

Extrusions—Four-page brochure illustrates over 50 typical cross sections of shapes, rods, strips, and tubes which can be custom extruded from thermoplastics. General specifications of the various types of extrusions are given. Fabricated components which can be made from extrusions are also covered. *Anchor Plastics Co., Inc., 36-36 36th St., Long Island City 6, N. Y.*

Quality control—Outlined in "Quality Control and Research" are the possible accomplishments and the probable cost of installing a quality control system, especially for the small-scale producer. 25¢. *Scientific Apparatus Makers Association, 20 N. Wacker Dr., Chicago 5, Ill.*

Services and facilities — Equipment, production methods, and services available from a company active in the fields of rubber and vinyl are described and illustrated in this 20-page booklet. These include, for vinyl, facilities for product design, model making, mold making, chemical research, production, and quality control. *The Sun Rubber Co., Barberton, Ohio.*

Porous metals — Information on types, performance, applications, and properties of controlled-porosity metals, including Type 304 and 316 stainless steels, nickel, monel, stellites, and others, are presented in this 45-page booklet. Included are data on various porous stainless steel filter elements and containers and their laboratory applications in plants. Design and engineering services are also outlined. *Micro Metallic Corp., 30 Seal Cliff Ave., Glen Cove, N. Y.*



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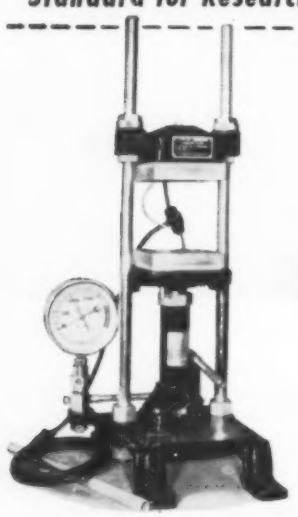

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Production of

FOR the purpose of this report, production is the sum of the quantities of materials produced for consumption in the producing plant for transfer to other plants

PLASTICS AND SYNTHETIC RESIN PRODUCTION IN
From Statistics Compiled

Materials	*Total p'd'n. first 10 mos. 1954*	*Total sales first 10 mos. 1954*
CELLULOSE PLASTICS:[a]		
Cellulose acetate and mixed ester		
Sheets, under 0.003 gage	14,532,723	14,462,571
Sheets, 0.003 gage and over	9,814,417	10,421,134
All other sheets, rods, tubes	4,728,246	4,311,537
Molding, extrusion materials	62,742,841	61,852,436
Nitrocellulose sheets, rods, tubes	4,621,323	4,117,744
Other cellulose plastics	4,601,336	4,194,282
PHENOLIC AND OTHER TAR-ACID RESINS:		
Molding materials[a]	148,338,679	137,877,846
Bonding and adhesive resins for:		
Laminating (except plywood)	53,003,786	36,189,964
Coated and bonded abrasives	8,071,817	8,723,840
Friction materials (brake linings, clutch facings, etc.)	12,528,499	12,008,067
Thermal insulation (fiber glass, rock wool)	28,599,179	29,663,209
Plywood	23,628,337	22,693,464
All other bonding and adhesive uses	10,976,777	11,148,576
Protective-coating resins	19,720,773	17,836,648
Resins for all other uses	22,044,867	19,754,749
UREA AND MELAMINE RESINS:		
Textile-treating and textile-coating resins	28,979,671	25,862,670
Paper-treating and paper-coating resins	16,608,647	15,516,574
Bonding and adhesive resins for:		
Plywood	63,540,441	59,798,165
All other bonding and adhesive uses, including laminating	19,597,514	18,570,957
Protective-coating resins	22,875,077	17,198,806
Resins for all other uses, including molding	54,885,824	52,372,832
STYRENE RESINS:		
Molding materials[a]	266,725,609	254,320,972
Protective-coating resins	71,547,378	66,965,230
Resins for all other uses	76,463,218	71,074,576
VINYL RESINS, total[b]	420,324,191	420,359,436
Polyvinyl chloride and copolymer resins (50 percent or more polyvinyl chloride) for:		
Film (resin content)		57,003,810
Sheeting (resin content)		47,772,508
Molding and extrusion (resin content)		118,064,164
Textile and paper treating and coating (resin content)[c]		40,460,720
Flooring (resin content)		26,990,085
Protective coatings (resin content)		19,479,119
All other uses (resin content)		27,526,106
All other vinyl resins for:		
Adhesives (resin content)		22,959,717
All other uses (resin content)		59,850,545
COUMARONE-INDENE AND PETROLEUM POLYMER RESINS	156,446,372	167,105,415
MISCELLANEOUS:		
Molding materials[a, d]	157,557,891	149,419,026
Protective-coating resins[e]	6,223,308	3,184,927
Resins for all other uses[f]	102,528,599	105,427,514

* Dry basis designated unless otherwise specified.
** Partially estimated. † Revised.
[a] Includes fillers, plasticizers, and extenders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

Plastics Materials

of the same company, and for sale. Sales include only the quantities involved in bona fide sales in which title passes to the purchaser.

POUNDS* FOR SEPTEMBER AND OCTOBER 1954 by U. S. Tariff Commission

*September***		*October***	
Production	*Sales*	*Production*	*Sales*
1,774,922	1,737,388	1,370,770	1,344,848
1,053,087	1,241,892	1,166,619	1,153,447
602,123	580,384	536,689	450,761
7,839,615	7,761,198	7,520,059	7,899,755
362,489	468,479	332,185	299,802
585,904	500,231	415,558	469,693
15,686,286	15,419,927	15,050,373	14,596,005
5,408,404	3,931,281	5,944,258	3,852,064
953,296	1,025,179	985,573	973,017
1,278,538	1,352,616	1,495,501	1,296,325
3,301,138	3,385,237	3,150,282	3,270,647
3,184,656	3,011,566	3,109,967	2,865,856
1,057,792	1,059,560	1,182,777	1,209,509
2,171,490	1,789,221	1,993,906	1,526,403
2,649,176	2,243,587	2,138,295	2,422,872
2,934,280	2,772,941	2,899,587	2,849,389
1,707,000	1,992,783	2,433,320	1,872,071
7,451,773	6,984,172	7,123,204	7,071,027
2,174,110	2,528,698	2,476,281	2,013,904
2,504,523	1,977,634	2,613,177	1,827,637
5,320,985	5,417,794	6,199,356	5,801,216
30,502,264	27,142,089	31,592,764	27,700,072
6,273,822	6,155,471	6,763,759	6,341,686
6,849,588	5,951,981	7,603,439	6,453,360
44,388,978	45,208,807	48,969,787	45,381,332
	5,664,779		5,427,106
	4,340,151		4,226,742
	13,454,339		13,456,189
	3,784,238		3,889,659
	3,797,141		3,688,206
	2,241,990		2,198,369
	3,778,755		3,515,048
	2,379,392		2,215,227
	5,768,022		6,764,786
20,268,386	20,615,677	18,424,549	18,239,872
†16,074,965	†16,891,951	19,573,015	16,383,281
419,112	324,651	724,234	330,315
†11,697,998	†12,441,076	13,097,813	13,522,068

data for spreader and calendering-type resins. [d] Includes data for acrylic, polyethylene, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins. [f] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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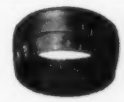

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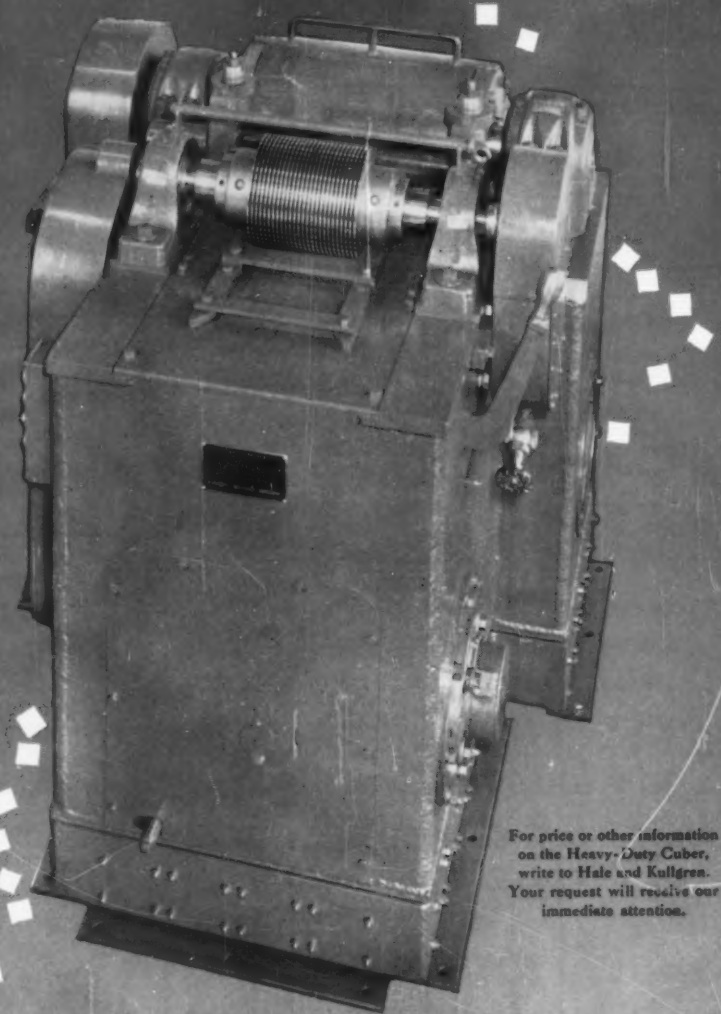

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Reinforced Plastics Conference

Detailed program of exhibit and technical and management sessions

THE Tenth Annual Conference of the Reinforced Plastics Div. of The Society of the Plastics Industry, Inc., will be held February 8th through 10th, 1955, at the Hotel Statler, Los Angeles, Calif. Registration will begin at 12:00 noon on Monday, February 7th, and will carry over into Tuesday morning.

For employees and officers of S.P.I. member companies, registration fees will be $15.00 per person; non-members will be charged $25.00 per person. Government representatives will pay no registration fees.

In conjunction with the conference, an exhibit of recent developments in reinforced plastics will be open to representatives from end-user industries.

A list of the papers to be delivered at the conference and the panel sessions that will be held follows:

Tuesday, February 8

9:30 A.M. to 12:00 Noon—Aircraft Session

Welcome address: Richard Malamphy, Naugatuck Chemical, Div. of U. S. Rubber Co.

Presiding: Carl R. Lemons, Douglas Aircraft Co., Inc.

Recording secretary: W. Brandt Goldsworthy, Industrial Plastics Corp.

The following papers will be delivered:

"General Review of Reinforced Plastics in Aircraft," M. Elber Latham, Swedlow Plastics Co.

"Success is in the Air," Robert W. Matlock, Zenith Plastics Co.

"Fabricated Flat Sheet Applications in Aircraft," H. H. Rosenbaum, Consolidated Vultee Aircraft Corp.

"High Temperature Applications," Donald M. Hatch, Hughes Aircraft Co.

"Reinforced Plastic Wind Tunnel Compressor Blades," Jack R. Brown and Ira M. Zeasman, Boeing Airplane Co.

1:00 to 2:30 P. M.—Luncheon—Aircraft Session

Presiding: Richard H. Malamphy, Naugatuck Chemical, Div. of U. S. Rubber Co.

Address: "Futures Unlimited for Reinforced Plastics."

Principal Speaker: Col. R. W. Green, Chief, Materials & Industrial Manpower Div., Directorate of Ind. Resources, U.S.D.A.F.

2:30 to 5:00 P. M.—Contact Period

Molders and fabricators to remain in individual rooms.

8:30 to 10:30 P. M.—Concurrent Sessions on Military Application and Reinforced Plastics Tools

Session I—Military Forum

Presiding: John B. Alfers, Dept. of the Navy, Bureau of Ships.

Recording secretary: Billy B. Curl, Jonasch Plastics Co.

Subjects to be covered follow:

"Recent Uses of Glass Reinforced Plastics in Army Ordnance," Harry E. Pebly, Jr., Ordnance Corps, Picatinny Arsenal, Dover, N. J.

"Prestressed Reinforced Plastics," Sol Goldfein, Corps of Engineers, U. S. Army, Engineer Research & Develop. Labs., Ft. Belvoir, Va.

"Specification for Plastic Assault Boat," Philip Mitton, Corps of Engineers, U. S. Army, Engineer Research & Development Laboratories, Fort Belvoir, Va.

"Pilot Production of Parallel Glass Fiber and Evaluation in Reinforced Plastic Applications," James W. Case, Dept. of the Navy, Bureau of Ordnance and Dr. J. D. Robinson, The Firestone Tire & Rubber Co.

"The Inspection of Glass Reinforced Laminates," F. Robert Barnet, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

"Improved Reinforced Plastics With the Universal Type Chemical Finish, No. 24," P. Erickson and I. Silver, U. S. Naval Ordnance Laboratory, Silver Spring, Md.

"Some Fundamental Considerations Governing the Use of Reinforced Plastics in Aircraft Structures," J. M. Stevens, Dept. of the Navy, Bureau of Aeronautics, Washington, D. C.

"Minesweeping Floats," W. R. Graner, Dept. of the Navy, Bureau of Ships, Washington, D. C.

"Problems in Design Engineering, Inspection, and Quality Control for Simplified Quantity Production of Reinforced Plastic Marine Craft," K. Telford Marshall, Transportation Corps, U. S. Dept. of the Army, Fort Eustis, Va.

Session II—Reinforced Plastics Tools

Presiding: Lawrence Wittman, Cordo Molding Products, Inc.

Recording secretary: Edward A. Jonasch, Jonasch Plastics Co.

Subjects to be covered follow:

"Review of Materials and Processes in the Production of Tools Made of Reinforced Plastics," Robert H. Voss, Warren Plastics & Engineering, Inc.

"Tooling for the Entire Reinforced Plastics Industry," M. K. Young, United States Gypsum Co.

"Aircraft Jigs and Fixtures," G. J. Walkey, Lockheed Aircraft Corp.

Wednesday, February 9

7:30 A. M.—Speakers' Breakfast

9:00 A. M. to 12:00 Noon—Session: Construction and Corrosion Resistant Applications

Presiding: John S. Berkson, Alsynite Co. of America.

Recording secretary: George Huisman, Plexolite Corp. of Calif.

Papers to be given follow:

"Present Status of the Reinforced Plastics Pipe Field," George A. Stein, A. O. Smith Corp.

"Corrosion Resistant Reinforced Plastics Tanks," B. H. Gardner, The Chemical Corp.

"Challenge of Reinforced Plastics in the Construction Field," Robert Fitch Smith, Architect, A.I.A.

"Corrugated Reinforced Plastics Panels in the Construction Field," Joseph S. Finger, Corrulux Div., Libbey-Owens-Ford Glass Co.

"Flat and Expanded Sheets in Construction," A. W. Russell, Russell Reinforced Plastics Corp.

1:00 to 2:30 P. M.—Luncheon

Presiding: W. Burdette Wilkins, Consultant.

Address: "An Architect Looks At Reinforced Plastics," Ulysses Floyd Rible, President, Southern Califor-

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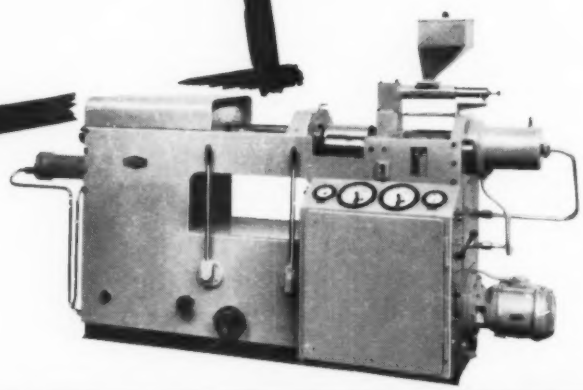

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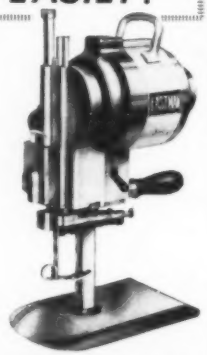

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2:30 to 5:00 P. M.—Contact Period

Representatives of resin, filler, and reinforcement manufacturers, mold and machinery manufacturers, designers and consultants, and government representatives, to remain in individual rooms.

8:30 to 10:30 P. M.—Concurrent Sessions: Electrical Session and Forum on Tools for Molding Reinforced Plastics

Session I—Electrical Session

Presiding: Roger B. White, The Glastic Corp.

Recording secretary: M. B. Crawford, Naugatuck Chemical.

"Elevated Temperature Properties of Electrical Grade Polyester Glass Laminates," Harry R. Sheppard, Westinghouse Electric Corp.

"Paper Reinforced Polyester Strip For Rapid Production of Electrical Punchings," Fred B. Shaw, Continental Can Co., Inc., Conolite Research Dept.

"Glass Reinforced Moldings in Aircraft Electrical Components," L. W. Landeck, Westinghouse Electric Corp.

Session II—Tools For Molding Reinforced Plastics

Presiding: Arthur J. Wiltshire, The Apex Electrical Mfg. Co.

Recording secretary: George Lubin, Bassons Industries Corp.

"Steel Molds," John C. Moricoli, The C. L. Gougler Machine Co.

"Finishes and Heating of Aluminum Tooling," John Avignone, M. A. Cuming & Co., Inc.

"Sprayed Metal Molds," W. E. Glidden, Glidden Coating Co.

"Non-Metallic Molds," Edward A. Jonasch, Jonasch Plastics Co.

Thursday, February 10

7:30 A. M.—Speakers' Breakfast

9:00 A. M. to 12:00 Noon—Session: Transportation, Housings, and Materials Handling

Presiding: George L. Smead, Libbey-Owens-Ford Glass Co.

Recording secretary: Clare E. Bacon, Owens-Corning Fiberglas.

"Reinforced Plastics Boat Industry," I. M. Scott, Winner Mfg. Co.

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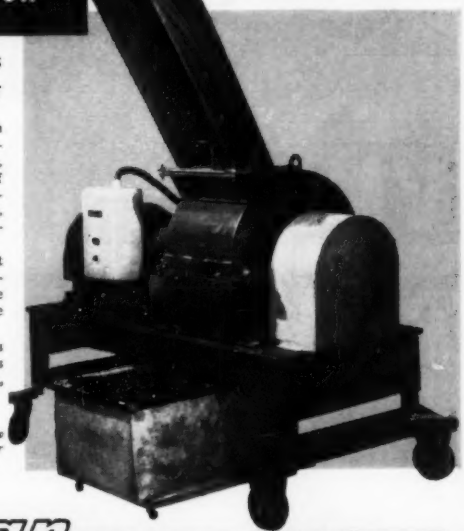

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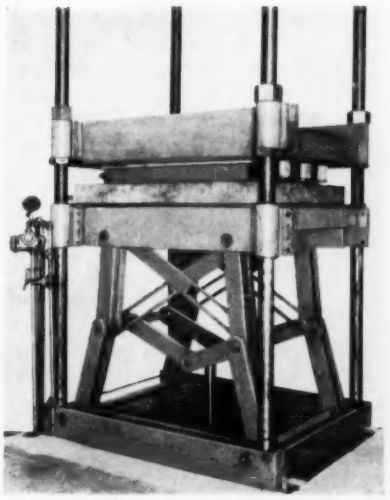

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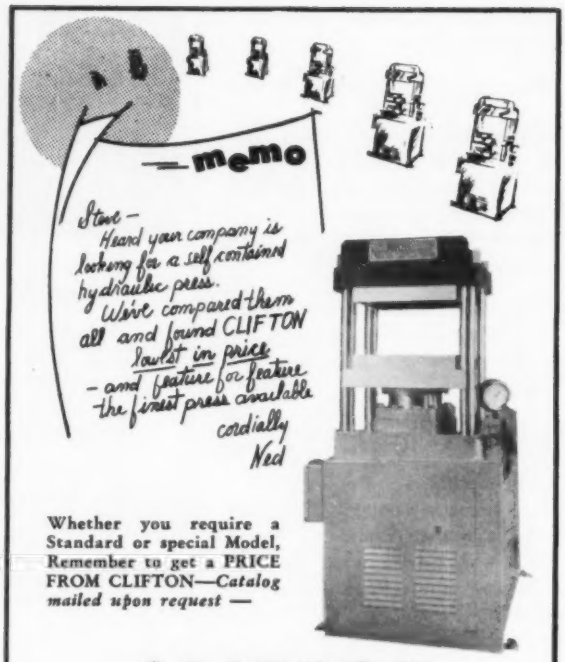
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"Case Histories in Materials Handling," A. W. Levenhagen, Molded Fiberglass Tray Co.

"Air Conditioner Housings," Charles D. Jones, Structurlite Plastics Corp.

"The Carrying Case Field," M. Martin, Bassons Industries Corp.

"The Do-It-Yourself Market," W. M. Frechette, Thalco.

1:00 P. M.—Luncheon

Presiding: Hiram McCann, MODERN PLASTICS.

Address: "How to Promote and Develop Your Markets," Dr. Lawrence C. Lockley, Dean, School of Commerce, Univ. of Southern Calif.

2:00 to 4:30 P. M.—Open Forum

Presiding: Robert J. Brinkema, R. J. Brinkema Co.

Recording secretary: Samuel S. Oleesky, Micronics, Inc.

(Panel to consist of representatives who delivered papers during preceding three days.)

6:00 P. M.—Reception

7:30 P. M.—Annual Banquet

Toastmaster: Samuel S. Oleesky, Micronics, Inc.

The following papers will not be delivered at the conference, but will be published in the preprint book which includes preprints of all papers to be given during the conference and which will be distributed to all registrants. The five authors of the papers, however, will be available for the question-and-answer period at the open forum on Thursday, February 10th.

"A New Development Project Involving a Unique Process by Which an Overlay Sheet is Combined With Polyester Fiber Glass in a Simultaneous Operation for Producing Machine Covers," F. W. Reynolds, I.B.M.

"Trouble Shooter's Guide to Polyester Molding," J. R. Lawrence, Rohm & Haas Co.

"The Design and Development of a Foamed-in-Place Sandwich Wing," Norman E. Wahl, Cornell Aeronautical Laboratory, Inc.

"The XQ-10 Plastic Target Drone," H. G. Spencer, Radioplane Co., Div. Northrop Aircraft, Inc.

"Screw-Holding Power of Polyester Laminates," R. R. Dixon, Westinghouse Electric Corp.—END

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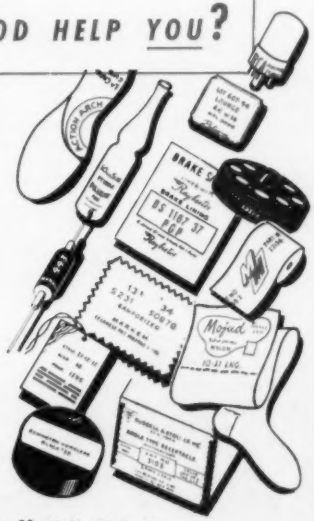

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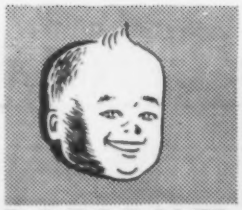

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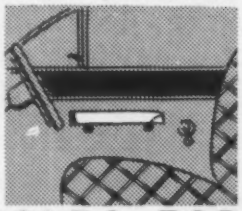

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Acrylic-glazed window (foreground) was twisted from its frame in a warehouse building (background) by hurricane winds and blown a distance of 100 ft., yet panes were unbroken

Hurricane-Proof Acrylic Glazing

THAT acrylic glazing panels can stand up to the onslaught of roaring winds in the 100 mile-an-hour speed range was proved during one of the hurricanes that ripped through the Eastern seaboard in the fall of 1954.

One case in point was found at the warehouse of the Keystone Refining Co., Philadelphia, Pa. Several months prior to Hurricane Hazel, shatterproof translucent acrylic glazing panels were installed in the warehouse in place of glass panes. This move was intended primarily to eliminate the $400 yearly window replacement bill that resulted from breakage of glass panes. At the same time, it was felt that the excellent light diffusing properties of the acrylic glazing materials would increase the amount of effective daylight inside of the warehouse—keeping it bright and cheerful even on dark and cloudy days. (See "Acrylic Windows," MODERN PLASTICS, 32, Oct. 1954, p. 198).

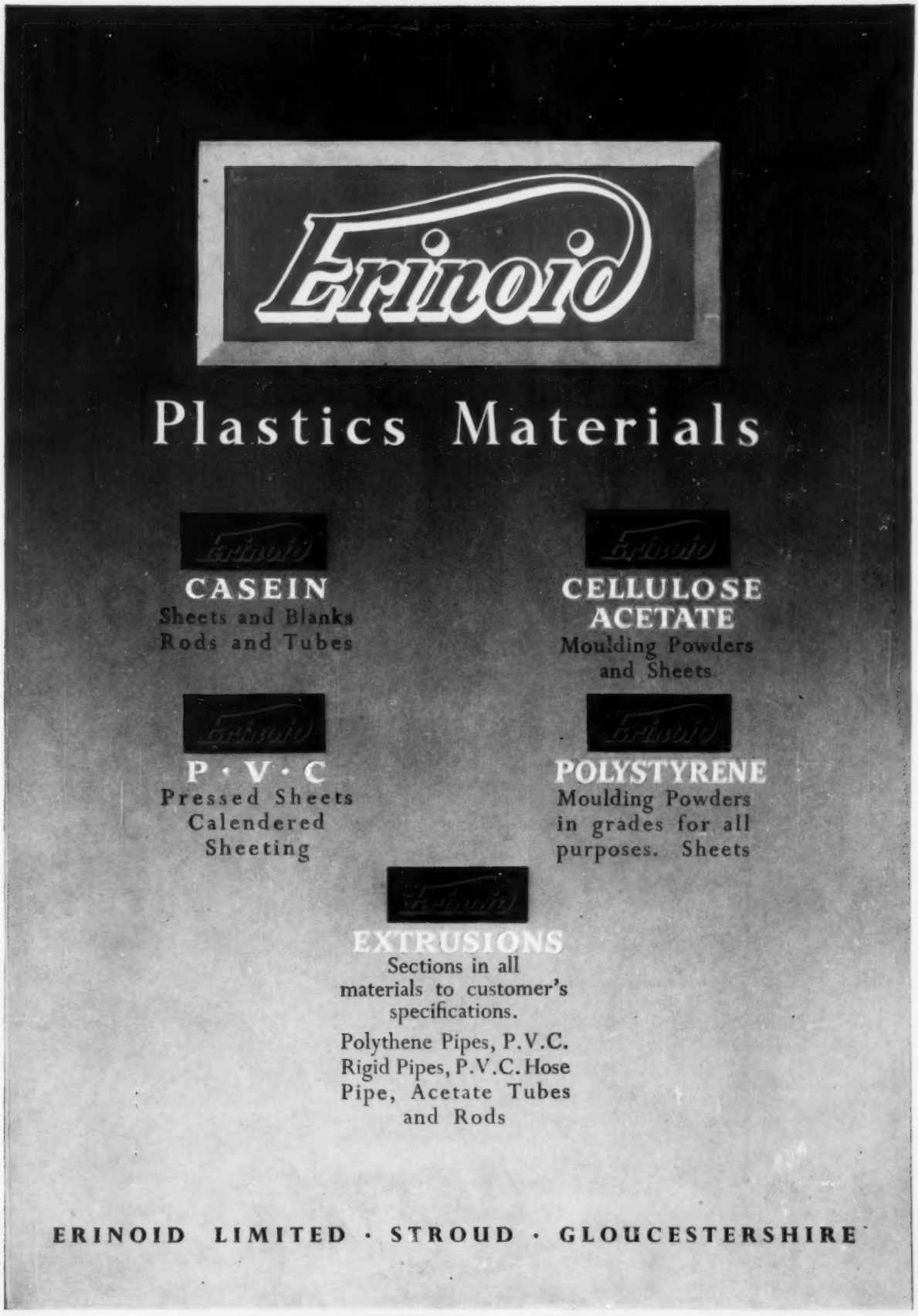
According to maintenance engineers at the Keystone warehouse, the acrylic panels amply fulfilled both objectives. Despite the hazards to which the panels were normally subjected by general industrial traffic, there were no recorded instances of breakage. Sky glare was also reduced to a minimum and a distracting view of outside traffic was eliminated.

And then, in October, 1954, came Hurricane Hazel.

Sweeping down on the warehouse with a force that ripped off the roof and blew down one wall, the devastating winds put the panels to a severe test. Despite extensive damage to the building itself, the acrylic glazing panels came through virtually unscathed.

One window was blown a distance of 100 ft. when the frame in which it was installed was twisted from a collapsing wall, yet (see photo) it was unbroken. Another window, blown to the floor of the warehouse, was struck by a heavy building block which broke through one pane but did not shatter it. The fact that the remaining windows in the three upright walls were generally undamaged adds further testimony to the breakage resistant properties of the translucent, shatterproof acrylic window panes in industrial glazing applications.

CREDITS: The acrylic glazing panels were fabricated from Plexiglas acrylic sheet supplied by Rohm & Haas Corp.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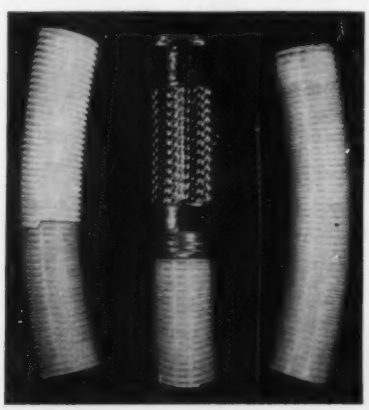
According to the manufacturers of the hose, polyethylene film was selected for the application because of its toughness and durability, its chemical inertness, and the fact that it will not impart an off-taste to food products. The stretchability of polyethylene film also contributes to the outstanding flexibility of the hose. A wire hose wrapped in five plies of thin-gage film is capable of being bent into a circle ten times its own diameter at —40° F. without damage.

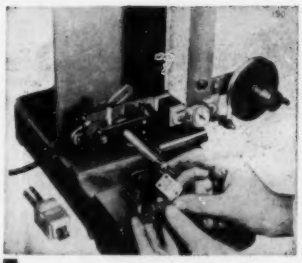
Where additional reinforcement is necessary, the polyethylene-covered hose can be armored with a stainless steel braid or with an abrasion-resistant vinyl sheath. One such vinyl-polyethylene covered hose is used by U. S. Army Ordnance for fueling guided missiles with red-fuming nitric acid—and after a year's field service, is virtually as good as new.

The hose, which can be produced in continuous lengths, is available in stock sizes of 1 and 2 in. inside diameter in 20-ft. lengths. Larger diameters and longer lengths are available on special order.

CREDITS: Hose was developed by Plastiflex Co., Santa Monica, Calif.; polyethylene film is supplied by The Visking Corp., Plastics Div., Terre Haute, Ind.



Hose wrapped with polyethylene film (right) can be reinforced with vinyl (left) or steel braid sheaths (center)



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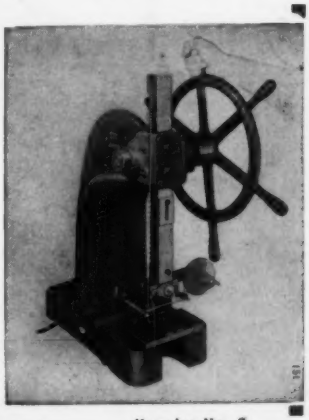

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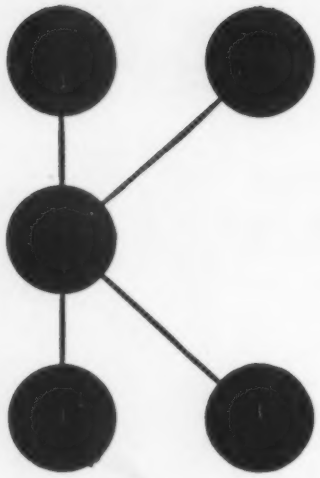

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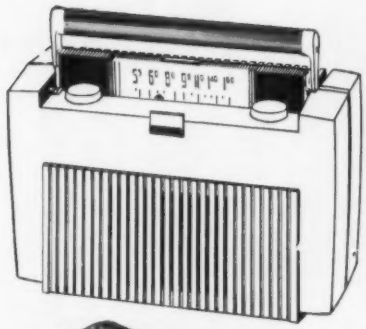

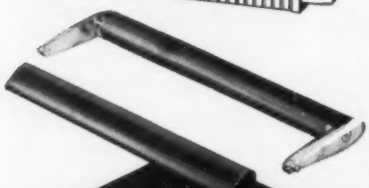

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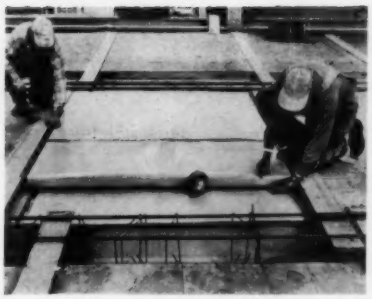

Form lined with polyethylene-coated paper produces better concrete surface

Form Lining

CONCRETE with a hard surface, free of costly-to-remove fins and smooth enough to be painted without special preparation, can be produced at low cost by lining the wooden form into which the concrete is poured with paper and tape coated with polyethylene.

The paper is simply laid into the wooden form with the coated side facing up and then cut to fit. Where the paper has to be pieced together, strong cloth tape coated with polyethylene is used. Tape is also applied along the joints where the wooden form adjoins the structural steel beams of the building. This sealing of the joints prevents the concrete from oozing out around the edges of the form and hardening into unsightly fins.

The concrete is then poured into the form. Because of the low moisture vapor transmission rate of the polyethylene-coated paper and tape, the curing time of the covered concrete is extended, giving it a harder surface. The lining also enables the wooden form to be removed, without impairing the finish or hardness of the concrete, much sooner than would be possible with unlined forms.

After removal of the form, the paper can be left in place as long as desired and then easily stripped off by hand. The resulting surface, as compared with the grained surface produced by an unlined wooden form, is unusually smooth and glossy and does not require any additional finishing before decoration.

CREDITS: Lining process developed by Lowe Paper Co., Ridgefield, N. J., and Permacel Tape Corp., New Brunswick, N. J. Polyethylene material supplied by Bakelite Co.

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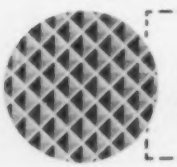

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Cup Dispenser

TRANSPARENT cellulose acetate and colorful styrene are put to effective use in the design of the three basic components of an attractive new home dispenser for paper cups. The long cylindrical tube of the dispenser in which the cups are stacked is fabricated of transparent cellulose acetate sheeting; the base of the unit which holds both tube and cups in place, and the shallow lid which fits on top of the tube to protect the cups from dust or dirt, are both molded of tough, high-impact styrene.

When in use, the dispenser is attached to the wall by a screw which passes through a hole molded into the back of the base. The tube is then

Cup dispenser has molded styrene base and lid; tube is made of acetate sheet

filled from the top with the paper cups. Three sloping projections molded into the bottom inside rim of the base engage the lips of the cups to prevent them from falling out. The sloping design of the projections, however, permits the cups to be easily pulled out for use, one at a time, without being bent, broken, or otherwise damaged.

According to the manufacturers of the dispenser, the light weight of the two plastics, coupled with outstanding strength and resiliency, also played a role in reducing packaging and shipping costs.

CREDITS: Dispenser is marketed by Dixie Cup Co., Easton, Pa. Acetate tube is fabricated by Acetate Box Corp., Brooklyn, N. Y. and base and lid are molded by Modern Molders, Inc., Kenilworth, N. J. Vuepak cellulose acetate sheet and Lustrex Hi-Test 88 styrene supplied by Monsanto Chemical Co.

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Rugged, easy-to-wash jam jars and handy toast plate molded of melamine in contrasting soft pastel colors lend added consumer eye appeal to new toast service

Melamine Jars

ATTRACTIVE "Toast 'n Jam" set that provides a convenient toast service for breakfasting or casual entertaining includes two jam jars and a handy toast plate molded of melamine.

The complete set, which is made by Toastmaster Products Div., McGraw Electric Co., Elgin, Ill., contains, in addition to the melamine pieces, a modern wrought-iron rack to hold the jars; a streamlined, functional toaster; and a handsome walnut serving tray lined with vinyl colored to simulate leather.

In merchandising the set, McGraw Electric places special emphasis both on the outstanding durable properties of the melamine jars and plate and on the ease with which they can be safely washed in hot water either by hand or in an automatic dishwasher.

An additional merchandising feature of the versatile melamine pieces is the double-duty role they take when not being used as part of the toast service. The toast plate, for example, doubles as a serving tray for hors d'oeuvres, relish, or bread, while the jam jars, with their snug fitting covers, are ideal containers for storing jams and jellies in the refrigerator.

The soft pastel colors of the melamine pieces also lend added eye appeal to the service set. Two handsome color combinations are available. For the "super de luxe" set, the plate and jam jars are molded in grey with the jar covers blue and terra cotta red; for the "de luxe" set, the plate and jars are sand-colored, while the lids are colored in contrasting bright orange and chocolate brown.

All three of the melamine pieces are molded separately in a 150-ton compression press. The toast plate is molded in a two-cavity mold; the jam jars and the shallow jar covers are each compression molded in a six-cavity mold.

CREDITS: The jam jars and toast plate are molded by Whitso Co., Inc., Schiller Park, Ill.; Melmac melamine is supplied by American Cyanamid Co.

Jars can double as storage containers; plate can be used as a serving tray

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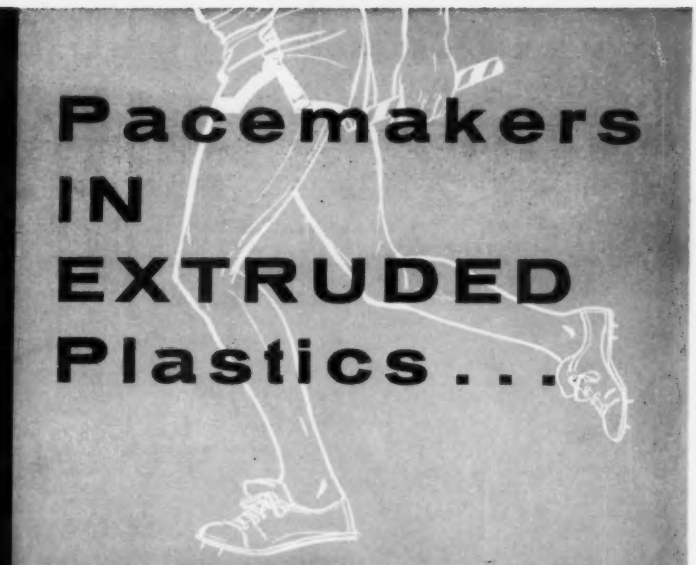

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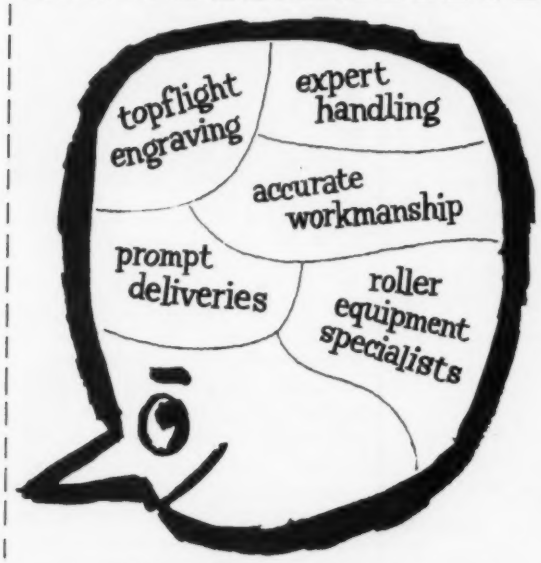

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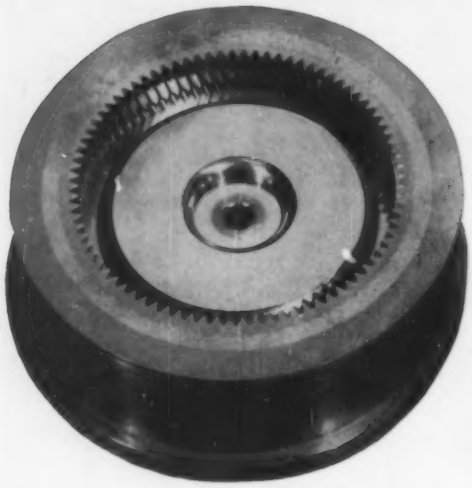

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Catwalk Car

EQUIPPED with a transparent acrylic top that permits an unobstructed view of traffic, a new experimental two-way electric catwalk car recently installed in one tube of the Holland Tunnel in New York City is being considered as a possible replacement for foot patrols in all New York vehicular tunnels. Traffic engineers feel that the motorized car will permit officers to cover their tunnel posts faster and with greater convenience than is now possible and will consequently result in better supervision of traffic and assistance to motorists who find themselves in difficulties.

As installed in the Holland Tunnel, the car, measuring 2 ft. wide, 11 ft. long, and 6 ft. high, runs on a 2200 ft. long section of miniature track on a 2½ ft. wide catwalk. The vehicle is equipped with a reversible seat and its movement at speeds of

Catwalk car for patrolling vehicular tunnel has transparent acrylic top

6 or 12 miles an hr. in either direction is controlled by duplicate sets of push buttons. The car stops automatically when the speed control button is released or when it approaches the end of the track in the tunnel.

According to Port of New York Authority maintenance engineers, who designed and developed the car with the assistance of the Special Devices Div. of The Austin Co., New York, N. Y., acrylic was selected for the application because of strength, optical clarity, light weight, and the effective protection it offers to the traffic officers riding inside the car.

CREDITS: Acrylic top fabricated by Steiner Plastics Mfg. Co., Inc., Glen Cove, N. Y., using Plexiglas acrylic supplied by Rohm & Haas Co.

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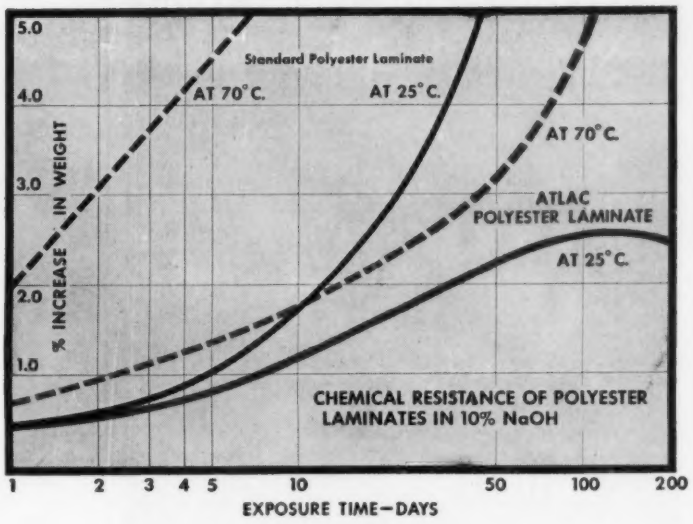

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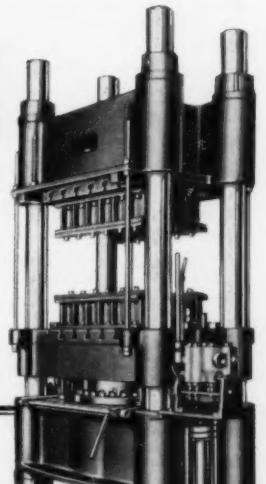

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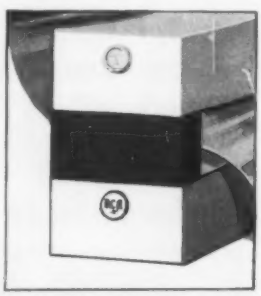

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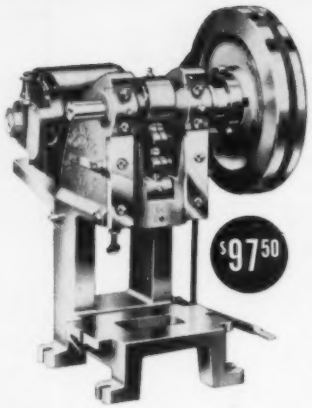

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Vinyl Bumper

A FLEXIBLE vinyl bumper that surrounds a metal carpet nozzle and prevents scratching or nicking of furniture is being installed on new model vacuum cleaners produced by the Lewyt Corp., Brooklyn, N. Y.

The rectangular-shaped bumper, 0.231 in. thick in its heaviest section, is injection molded in one piece with a slight undercut running completely around the inside rim. When assembling the bumper to the nozzle, the flexible vinyl piece is simply stretched to fit over the nozzle and allowed to snap back so that the undercut section securely grips a thin metal rim around the periphery of the nozzle. The bumper is produced in a two-cavity mold on a 12-oz. injection machine.

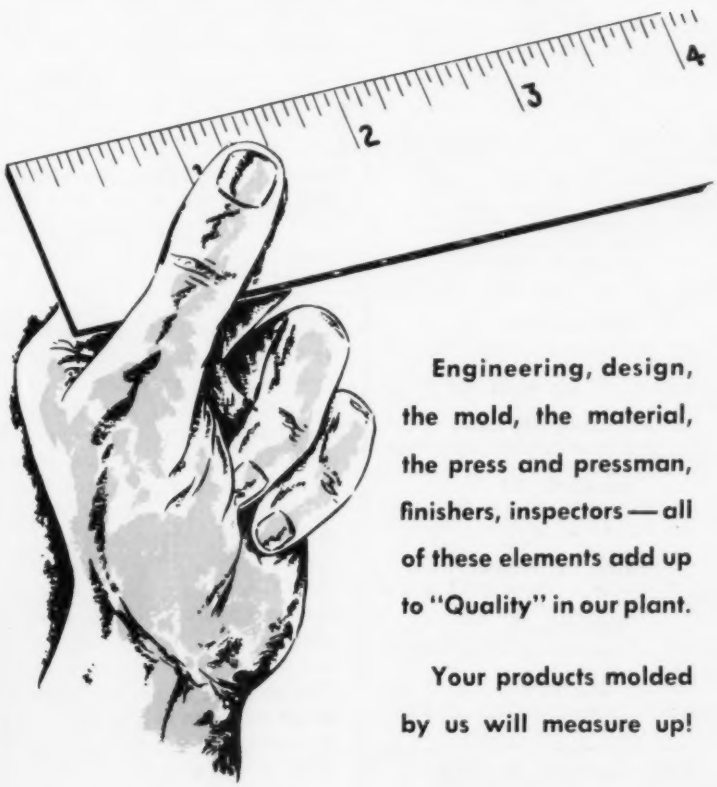
In addition to serving as a protective guard for the carpet nozzle of the cleaner, the attractive grey-colored bumper also enhances the appearance of the unit. Since color is integral with the tough, long-wearing piece, it cannot streak walls or furniture. The vinyl bumper also resists grease or chemical stains and can be wiped clean with a damp cloth after use to maintain its smooth, glossy finish.

For added eye-appeal, a series of raised parallel stripes are molded into the top surface of two sides of the bumper.

CREDITS: Bumper is molded for Lewyt Corp. by Hungerford Plastics Corp., Rockaway, N. J., on a 12-oz. Reed-Prentice machine.

Sharp edges of metal carpet nozzle are covered with protective vinyl bumper

Do People Measure Your Product By The Quality Of The Plastic Molding?



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Better Buildings

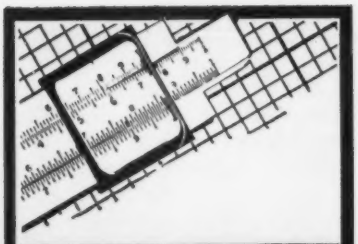
(*From pp.* 85-90)

highly-reinforced materials equal in strength/weight ratio to high-alloy steel. Inherent stiffness of most plastics is relatively low, but it ranges from completely flexible to three to four times that of structural timber. Creep, even at ordinary temperatures, can be serious in some plastics, depending upon the stresses, and should always be kept in mind. Expansion and contraction with temperature changes are high, higher than most materials of construction, and must be allowed for, especially when plastics are used in conjunction with other materials. Corrosion resistance is generally excellent, and some plastic can usually be found to withstand any corrosive or solvent condition to be found in building.

Probably the most important and at the same time the most uncertain factor is information respecting long-time durability and resistance to weathering. Twenty years is not a long time in the history of a building, but many plastics have histories shorter than that, particularly with respect to outdoor exposure. A few, such as the acrylics and the phenolics, have proved histories ranging up to 20 years or more; some show considerable promise on the basis of shorter exposure histories; others are known not to be acceptable for prolonged outdoor exposure. Most, if not all, of the structural plastics can be assumed to be acceptable for prolonged indoor use.

All plastics, like other materials of construction, can be destroyed or damaged by fire. Some burn readily, some with difficulty, and some will not support their own combustion. This factor is of obvious importance in the selection of any material, and it carries corresponding weight in building codes.

Plastics are relatively new materials of construction and, like all materials, must find their proper place. As is true of all materials, design must be based upon properties and must take into account strong points as well as limitations. When this is done, plastics should make a major contribution to building technology and should provide the architect with a new range of materials with which to satisfy his esthetic and functional needs.—END



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Tomorrow's Barn

(*From pp. 92-93*)

0.040 in. thick. To facilitate handling and to reduce the amount of edge-fastening required, six different-size panels are used, the average dimensions being equal to those of a 12 ft. equilateral triangle. The edges of each panel have molded-in channels which clip over and into a special groove in the frame members. An aluminum extrusion fastens the panels securely to the frame and waterproofing is achieved by applying a 4 in. wide pressure-sensitive tape along the joints and saturating it with polyester resin. A total of 5600 sq. ft. of laminate, weighing approximately 2800 lb., was used in the construction of the barn.

In addition to its effectiveness as a structural unit, the reinforced plastics barn offers many planning advantages unobtainable in conventional buildings.

Because of the translucency of the polyester-fibrous glass laminate, for example, the animals inside the barn receive sufficient light even on dark winter days and are shaded from direct sunlight during the summer months. The rugged panels are strong enough to support heavy snow loads, although the dome-like shape of the building itself provides in most instances for aerodynamic clearance of snow which simply slides off the sloping sides.

Because of the large size of the covered area, the animals never need to leave the barn, which is always kept at outside temperatures. Many agriculture specialists feel that this feature will enable the farmer to economically take advantage of modern cattle feeding and maintenance techniques that were heretofore considered impractical. Panels at the top of the barn can be opened to serve as ventilating louvers and openings at the base into which the panels fit are large enough to eliminate door framing problems.

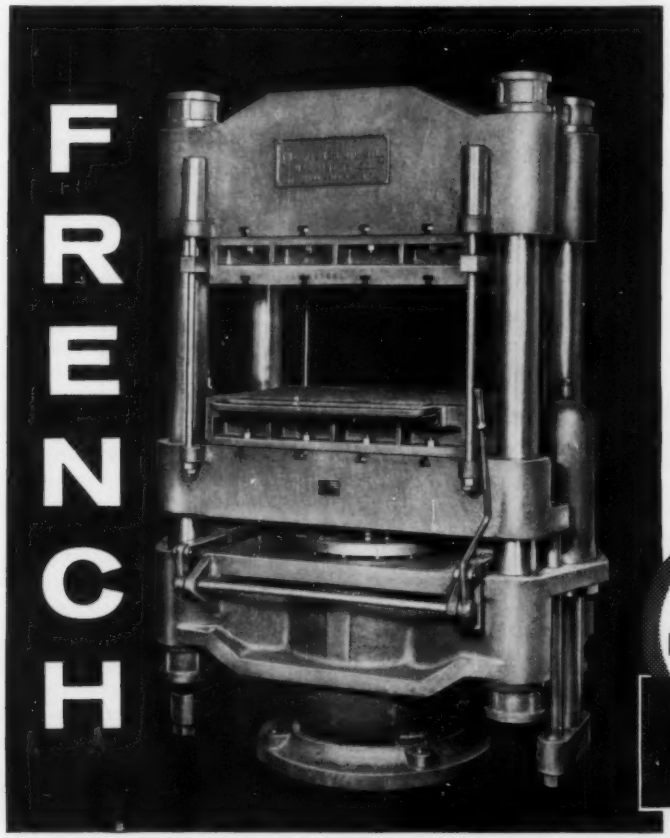
The barn will be open completely around the bottom in good weather and is curtained by an Orlon fabric skirt in bad weather.

Mass Production

The designers of the geodesic structures do not plan to sell the units, but will lease them through distributors. The optimum size is the 83½- by 32½-ft. dimension as used for the barn, but storage capacity can be increased by simply clustering a number of the domes together. It is expected that, after two years of field testing the prototype unit, the geodesic barns will be mass produced and mass distributed with resulting economies.

The unit is suitable for any general storage purpose or other uninsulated free space application, and will doubtlessly develop new uses in the future. Since the components for two complete storage buildings can be carried on one standard trailer truck, for example, the geodesic reinforced plastic shelter should find a ready market in remote regions, where both construction and storage are problems. The units can also be used to cover mine shaft heads, as well as to provide storage for almost any type of agricultural or industrial product.

CREDITS: Panels are fabricated by Polyfiber Ltd., Renfrew, Ontario, Canada; Laminac polyester resin supplied by American Cyanamid Co.; fibrous glass mat supplied by Fiberglas Canada, Ltd. Patent on geodesic structures is held by R. Buckminster Fuller. Construction by Jeffrey Lindsay and Assoc.



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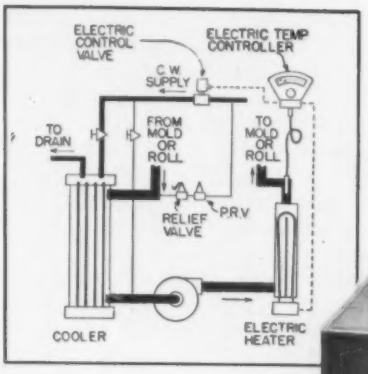

Schematic sketch of the control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits, MC-3 has 3 circuits.

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2081 F

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SARCO

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Freezer

(*From pp. 94-97*)

for the liners was determined by the extreme draws involved in forming the shelf supports, recesses, and can racks with their orphan inserts.

A number of interesting problems had to be worked out in connection with these inserts. Their coefficient of expansion was important and there was some evidence that strains might develop after the plastic had taken its final set around the inserts. Among the insert materials tested were various metals, rigid cardboard, plywood, and laminated phenolic sheet stock. All were rejected for various reasons and the parts are now being made with inserts precut from Tekwood, a wood-paper sandwich structure made by U.S. Plywood Corp.

The sequence of operations followed by Regal in producing the large Deepfreeze door panels, using a press of the company's own design, is as follows:

First, the aluminum die is cleaned off and the necessary inserts are pinned in place. It is particularly important that the inserts be so secured that they will not shift out of position during the forming operation, yet will be easily removed from the die after sheet is formed.

After the plastic sheet is framed in place on the forming machine and heated, a vacuum is pulled to draw the sheet down into the mold and around the inserts. At the end of a brief cooling cycle, the liner is lifted from the mold; at this point, the inserts part from the mold and remain in the liner undercuts. They cannot shift or fall out because the material closes in tightly around them during the forming process.

The liner is then punched and trimmed in a single operation in a toggle press which also shapes the outer edges of the part to final dimensions, simultaneously making any holes and other punchings that can be accomplished in the punching plane. Secondary operations produce additional holes and cut-outs.

Other vacuum formed plastics parts in the line of Deepfreeze appliances include a double-walled freezer compartment door and a tip-out crisper bin made by Fabri-Form, and an evaporator drain tray made by Woodall Industries.—END

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3D Vinyl Sheet

(*From pp.* 98-99)

will eventually form the vacuum holes are then driven into the board through the fabric. After spraying the fabric with metal to a thickness of approximately ¼ in., the metal mold is backed up with resin or plaster. The pins are then withdrawn, leaving air holes, and the fabric is removed. (See "Sprayed Metal Molds," MODERN PLASTICS, *30*, Sept. 1952, p. 105).

For electroformed molds, usual procedure is to drill the vacuum holes directly into the mold after it has been built up by a specialized electroplating process (See "Electroforming for Plastics," MODERN PLASTICS, *28*, March 1951, p. 81).

In the case of Original Plastics, mold making requires special care because of the unusually large number of vacuum holes needed to assure that the flexible sheet will be forced into all the undercuts of the complicated molds. The finer the detail desired in the formed pattern, the greater the number of vacuum holes that are necessary.

Straight vacuum machines are used by Original. With the female molds set up on the bed of the vacuum forming machine, the flexible sheet to be formed is laid on top. The edges of the sheet are then pulled down over a series of sharp pins inserted around the periphery of each mold and a metal clamping frame is lowered on top of the plastic sheet.

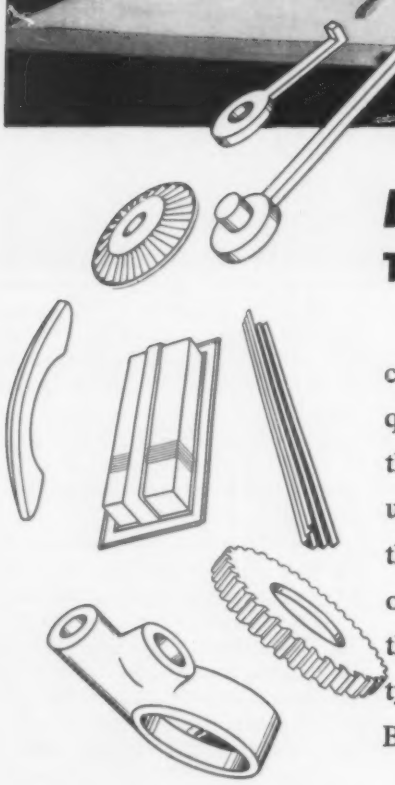
Sheet Easily Stripped

The sliding heater is rolled forward until it is located directly over the sheet. Heating cycle at 700° F. is generally about 30 seconds. The heater is then retracted, the vacuum is drawn, and the sheet is pulled tightly against all surfaces of the mold. When the sheet has cooled sufficiently, the vacuum is released and the formed sheet is removed. Because of the flexibility of the vinyl, the formed sheet can be easily stripped from the mold undercuts without permanent distortion.

At Original, both pigmented and transparent vinyl sheets are formed. To color the transparent sheeting, a simple but effective and low-cost method is used. The first color is applied to the flat areas of the formed sheet by a conventional paint roller. The entire sheet is then transferred to a spray booth where a second color is sprayed on. The result is a multi-color sheet with all flat areas and valleys appearing in one color and all raised portions showing in a contrasting color.

By using translucent pearl-colored sheeting and by applying the same coloring technique, a simulated pearl bead pattern can be created. To give an antique finish to the formed sheet, still another low-cost method is used. A single color is sprayed on the face of the sheet; before the coating is dry, it is carefully smeared with a cloth to create dark and light areas.

While personal accessories, novelties, and upholstery loom as the largest market possibilities for the vacuum formed vinyls at the present time, the undeniable eye-appeal of the materials, the economies, inherent in their production, and the outstanding physical properties of the vinyl sheeting itself have already attracted the attention of a number of other manufacturers who have long been users of conventional fabrics.—END.



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Plastics Teacher

(*From page* 103)

of a music roll housing which spans just under three full octaves of the piano keyboard. Two shafts mounted at each end of the housing are so arranged that the feed roll and wind-up roll may be snapped quickly into position in the open front and the end of the music sheet fed through a slot in the lower roll to "load" the device. The right end of the unit has a plastic rewind knob with metal finger grip, while the left end encloses a metal cam assembly which advances the lower roller each time the foot pedal is depressed.

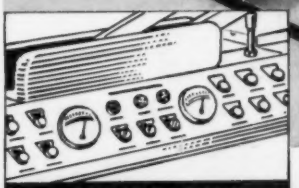
There are four injection molded plastic parts to the Play-It. The main housing section, made in a single cavity mold on a 24-oz. injection machine, measures 22 in. wide, 5½ in. deep and stands 5½ in. high. Weighing 19 oz., this component has the product name molded directly in the front, across the top, while decorative horizontal ribs on the right end cap lend a pleasing design detail.

The other three plastic parts of the Play-It include the left end plate, the rewind knob, and a hollow-shafted pin 1½ in. long, terminating in a domed circular head. All are produced in a three-cavity family mold on a 12-oz. injection machine. The end plate is molded with several cores and bosses which provide for assembly to the main housing and for mounting the enclosed metal parts which actuate the bottom roller shaft. Threaded metal inserts used for assembly purposes are press fitted into blind cores after molding.

The circular rewind knob, 2⅜ in. in diameter, is molded with the metal roller shaft as an insert for a positive, slip-proof fit. The small metal finger grip for the outer face of this part is press-fitted into place in a cored opening. This assembly is held in place in the end of the housing by means of a C spring which clips over the shaft. The right lower shaft mounting pin is cored in the mold to accept the shaft.

All metal stampings and assembly operations for the Play-It are handled by the molder, who supplies the finished piano attachments to Play-It, Inc., distributor of the device.

CREDITS: Play-It parts molded, fabricated, and assembled by Santay Corp., Chicago, Ill., using Dow 475 Styron material.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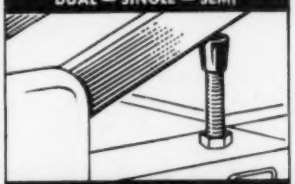
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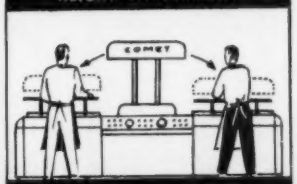

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Calendering

(*From pp.* 104-107)

additional 10,000 sq. ft. or a total of 15,000 sq. feet.

Equipment costs would be roughly $50,000 per oven for a modern, well engineered and constructed gas fired two-zone oven. Reverse roll coating heads would run around $10,000 each and let-off and take-up equipment would account for another $5000 to $6000 per unit. If simple knife coating heads were used they would run about $2000 per unit.

Therefore, for a coating unit with a capacity of 1200 lb./hr. spread, the approximate total equipment cost would be, if reverse roll coaters of the latest type were used, about $365,000 and would require 15,000 ft. of floor space. If simple knife coaters were used, the cost would be about $325,000 and the same floor space would be needed. These cost figures do not include the extra cost of drives for the roller coating heads.

Such a set-up would require a labor force of about 23 men to operate on reasonable workload standards.

A quick comparison of the two methods can be had from a summary of the data already presented:

CALENDERING

Equipment, Initial Cost, $300,000
Space (cost not incl.), 6000 sq. ft.
1 Unit
Labor, 10 men

SPREADING

Equipment, Initial Cost, $365,000
Space (cost not incl.), 15,000 sq. ft.
5 Units
Labor, 23 men

Comparison of Systems—In summing up the advantages and disadvantages of each system briefly, it appears that the advantages of the calendering system, not necessarily in the order of their importance, are: high output per unit; small labor force; minimum floor space requirements; single pass operation up to 20- to 25-mil film; single and simple control point; adequate gaging equipment and the mechanism to use it quickly for corrective purposes; and appreciably lower cost per yd. in production runs in the most commonly used range of weights of compound application.

Its disadvantages would include the necessity for a fairly high initial demand for the product to warrant

the high initial investment. In other words, a big business is needed to start with, to assure an immediate adequate return on initial cost. The vulnerability to damage and breakdown of a single unit plant, with consequent complete stoppage of production, cannot be passed over lightly. In addition, there is the high cost of short runs and inability to apply films lighter than 5 or 6 mils to woven fabrics without showing the weave too prominently, or producing a discontinuous film, plus the problem of controlling penetration or strike through.

Advantages which accrue to the spreading system include the ability to process film weights down to minimum thickness; here this system shines because, in the lighter weights, high speeds are usually attainable with consequent cost reductions. In coatings less than 5 mils thick, spreading will probably always be a lower-cost volume producer. Then, there is the ability to accommodate short runs at less over-all cost than the heavier equipment and the flexibility in operation whereby it is possible to spread any of the weights of film required within the limits given in this discussion. In addition, costs are substantially lower per unit, there is considerably less chance of complete production stoppage caused by equipment damage, and it is possible to start up on a small-scale investment base while maintaining a fairly competitive cost structure in heavier-weight applications.

The disadvantages of spreading could include higher initial cost for equal output; far lower output per unit; two to three times the floor space requirements; better than twice the labor force for the same output; inaccuracy of film application and the lack of ability to control it; a dirty and expensive can cleaning operation; the necessity of multiple passes to obtain medium- and heavy-weight applications, with the increased cost incident to additional handling; and the necessity for making provisions for handling explosive solvent vapors.

A Place for Both

That there is a place for both systems is borne out by the fact that estimated consumption of base resins in 1954 by the coated fabrics industry was reported to be about 23,000,000 lb. for calendering and 17,000,000 lb. for spreading.

If the prime objective is low-cost, high-volume production with an economic minimum of at least 10,000 lb. per day and film thicknesses in the medium-low to high ranges, then there seems to be no question but that the calender is superior and will continue to be so.

If the objective is to start on a modest scale with a minimum of investment, and if film thickness requirements are in the lower ranges and likely to remain so, then the obvious choice is a spreader system. But it must be remembered that production will be subject to cost fluctuations because of lack of ability to closely control spread.

The ultimate in equipment set-up based on developments in the art as they exist today, appears to be a calender set-up to be used as the workhorse and breadwinner of the outfit, backed up by one or two spreaders for short run and lightweight business and to economically take care of experimental and development work until it is ready for volume production on the calender.

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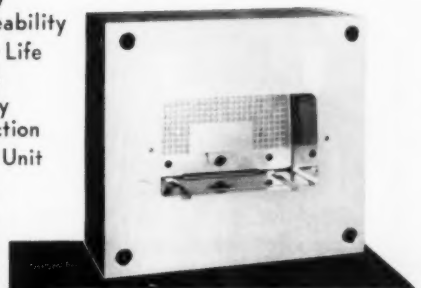

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Vinyl

(*From pp.* 110-111)

flooring in house construction, in roof construction, and, of course, for industrial covers or tarpaulins.

Automotive Uses

In the automotive industry, vinyl coated fabrics have grown from limited applications on seat facings and door trim pads on a Fisher Body in 1948 to a model completely trimmed in vinyl for 1955, according to **H. V. Beckerleg, Fisher Body Div., General Motors Corp.** The reason for the time lapse was the numerous failures which were often the result of using unsupported film.

Some of the problems which have been overcome, according to Mr. Beckerleg, were:

Retention of room temperature values in such factors as tear resistance, impact and sew line strength.

Resistance to changes in weather at temperatures from —20 to 200° F.

Ability to be decorated in almost unlimited surface effects and colors.

Ability to drape and tailor properly to contours as well as to be sewn without gumming up needles.

Problems still to be more fully overcome include:

Lack of color match.

Internal tension within a roll of coated fabric which results in cutting and sewing problems.

Inconsistencies in stretch characteristics of coated knit fabrics.

Complete elimination of plasticizer migration.

Inconsistencies in surface friction or ability to slide over a seat cushion without resistance.

The squeak that sometimes develops when films are rubbed lightly in contact with themselves.

Less scratching on the surface of rigid vinyl rear windows used in convertibles.

Among promising developments are non-woven fabric bases for coating; a vinyl-coated convertible top material consisting of two cotton sheetings, a rubber interlining, and an exterior surface of vinyl; vinyl-coated rubber-base floor coverings; and a foam vinyl and plastisol surface arm-rest pad.

Uses in Packaging

Packaging films also received attention in a paper by **E. J. Koch, Olin**

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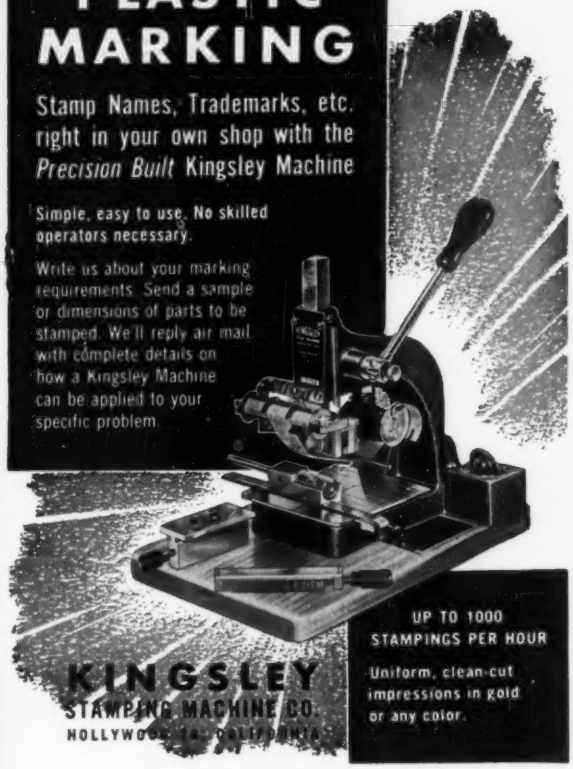
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Mathieson Chemical Corp. "The 'universal' packaging film is an impossibility," said Mr. Koch, pointing out that "a packaging film should have transparency, durability, purity, package machine runnability, printability, and it must be low in cost.

"In addition, a packaging film should be chemically inert, odorless, and tasteless. Non-flammability is desirable. Properties must be maintained over wide ranges of temperature and humidities. Gas and water vapor permeability are desirable and the degree of such permeability is dependent upon the end use of the film. For example, dried milk requires low water vapor permeability while bananas demand very high gas permeability."

It would be almost impossible to over-emphasize the above remarks. There are far too many persons in the plastics business who become over-enthusiastic over the possibility of any one film doing a universal job in packaging. Almost any film will have a few excellent properties, but the tough part of almost any packaging job is to find a film that will have a wide range of *satisfactory* properties. The experts' task is to find the film that will have the greatest number of adequate desirable properties at the lowest cost.

Film Laminates—Mr. Koch pointed out that the various film laminates now coming to market are a step in the right direction because such combinations give that many more properties to the finished material. Items such as dried soups, sugared cereals, cake mixes, etc., require protective properties not found in one film.

He also mentioned the fact that vinyl chlorides are gradually increasing their usefulness because of their versatility and the possibilities of variation in types of comonomers and molecular weights which can increase considerably their range of adaptability.

An interesting comment was made on the fact, that the plastics industry is always being told what it must do to serve the customer. The speaker suggested that it might be a good thing for the plastics industry to occasionally mention what it would like, too. Improved packaging machines, better adhesives, improved inks for work with plastics, would be just as welcome to plastics as better plastics would be welcome to the packaging and apparel or upholstery industries.

Uses for Saran

Saran or vinylidene chloride also received attention in a paper by **Grant W. Cheney, The Dow Chemical Co.** He pointed to the ups and downs of woven saran as a material for screen cloth and auto seat covers and declared that although the sale of colorful saran seat covers with new cars decreased in 1954 to something like 20% of the previous maximum, they had contributed to more serviceable and more colorful interior car styling. Then he conveyed the good news that saran had become a potential contender for a place in the original automotive upholstery field. In 1954, for example, saran body cloth became standard equipment for Ford Ranch Wagons and trucks. The market is expected to grow.

Saran in Furniture—The next big market is expected to be in furniture upholstery. Except in outdoor furniture, where saran is already well entrenched, this field has been a long time developing but it is now be-

lieved to be well on the way. One reason is a new polymer, Q-909, which it is believed will help to solve many of the problems of the past. The new polymer gives a three- to five-fold increase in light stability; and has substantially reduced shrinkage, highly improved static characteristics, and reduced odor.

Calendered Sheeting

Rigid vinyl sheeting produced by the calendering method was called to the conference table by **Lee Kuhn, Firestone Plastics Co.**, who emphasized the relatively narrow range of molecular weight in any given polymer system below which rigid vinyl sheet is simple to produce but impossible to sell because it is worthless and above which it would sell itself, but it is impossible to produce at a reasonable rate. Since the product must stay in this narrow range of molecular weight, the production problems are manifold and can be solved only by continuous experience.

Rigid vinyl sheet may be sold directly as-calendered or it may be post-processed into embossed or laminated forms. Surface appearance of sheets which are to be laminated is, of course, less critical than those intended for direct sale, but gage control and the degree of residual stress remaining in the sheet are vitally important in both. While a post operation, such as pressing, laminating, embossing, or vacuum forming may be helpful in correcting gage variation and removing residual stress, it is not good practice to depend on post processing to solve calendering problems.

Three types of formulation described by Mr. Kuhn are known as Type I, Type II, and that described under A.S.T.M. Designation D 708-53T as vinyl chloride polymer and copolymer rigid sheets.

Types of Sheet—Type I is designed primarily for chemical resistance. It contains no modifier and is described as having normal impact. It is seldom sold as-calendered but is generally laminated into thicker plates that may range from 0.015 to 1 in. thick. It is used largely in the chemical process industries.

Type II is primarily for high impact use and contains a modifier which, of course, means that some of the vinyl's congenital chemical resistance is lost. Types I and II are companion materials—when one isn't satisfactory, the other may be.

The D 708 sheets are copolymers based on vinyl chloride with the comonomer varying. Types I and II are primarily for functional applications; D 708 sheets are primarily decorative. Typical uses of the latter are in lamp shades, doll faces, point-of-sale displays, relief maps, drawing instruments, and luminous ceiling materials. D 708 seldom appears as a single calendered sheet and does not have the same chemical or impact resistance of Types I and II. Processing temperatures for D 708 are much lower than Types I and II, but vary widely depending on whether the stock is an unplasitcized copolymer or a plasticized P.V.C. The most common copolymer used, according to Mr. Kuhn, is vinyl acetate but others such as vinylidene chloride, maleate esters, and unspecified copolymers are also in the picture.

Among the growing industrial uses of vinyl film are pressure-sensitive adhesive tapes, of which approximately 8,000,000 lb. was used in 1954. Much of this went for electrical purposes, but gains are being made in the fields of pipe wrap, floor marking, and decorative uses in the home. In addition, facing materials for fibrous glass insulation, superior linings for concrete forms, dust barriers, and covers or tarpaulins are using more and more film.

How to Laminate

Laminating techniques for vinyl were discussed by **Vernon Pierce, Kaykor Industries, a Div. of Kaye-Tex Mfg. Co.**, who outlined the various techniques as follows:

Laminating on the calender—This method was once widely used for producing material used in inflatables, but was largely discarded when methods were devised for producing heavier sheet in one pass without pinholes. Today only 3 to 5% of the material used in inflatables is laminated on the calender. One fabricator laminates two 5- to 6-mil films by a solvent method and has another 10% of the market.

Laminating on the calender is expensive and is used only when a better material can be obtained in no other way or when it is desired to build up thicknesses that are beyond the feasible calender range. Mr. Price also stated that 10% of the vinyl-coated fabrics used in upholstery are made by post-laminating a pre-calendered film and an anchor-coated cloth.

Laminating with rubber and steel rolls is a system which uses a rubber roll and a steel cylinder, either smooth or embossed, which are forced together with adjustable pressure by air cylinders. Preheated films passed between the rolls are fused together. Since less vinyl is required for this method than in calendering, it is possible that it will gain favor although presently seldom used.

Press laminating—Clear vinyls are generally laminated by this method but presses of the type required are generally used for polishing vinyl sheet which goes to the handbag market. Rigid vinyl is also frequently laminated by the press method, which is an old, familiar process in the plastics industry.

The Rotocure laminating method used by Kaykor is an adaptation of a rubber processing method used for curing belts in continuous lengths. The equipment consists of a large drum, two idler rolls, and a high-tensile steel belt. Several plies of vinyl sheeting can be laminated in a continuous operation and strain-free sheets can be produced. Mr. Pierce reports that his company is producing flexible vinyl tank lining material in one pass at 7 to 8 ft./min., and an unplasticized sheet at 5 to 6 ft./min. and asserts that costs are approximately ⅓ that of press laminated sheets.

Predicting Properties

Another important technical paper was that by **L. H. Wartman, Bakelite Co.**, who showed how it was now possible to predict the final properties of a vinyl compound which is to be formulated with mixed plasticizers before the actual mixing is done. An expansion of Mr. Wartman's paper will be found starting on p. 139 of this issue.

The paper delivered by **deForest Lott, Textileather Div., General Tire & Rubber Co.**, which compared the economics of spread coating and calendered coating is presented in detail starting on page 104.—End

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When, How to Hob

(*From pp.* 117-124)

may be produced, especially when the hob and blank are so shaped that a wedge effect is created. These stretch marks are minimized by holding the blank in a ring or chase during hobbing.

After the last hobbing operation has been completed, the upper surface of the hobbing, which is irregular owing to unequal flow of the metal, is machined to whatever shape may be required to make it match the opposite die section. The die is then pack-hardened to a depth of about 1/16 inch. The final operation is polishing the surfaces of the impression to restore whatever luster may have been lost in the heat-treatment. If the operation has been carried out properly, the cavity will be a perfect replica of the hob, and the luster of the hob will be imparted to the die. This luster is more lasting in service than that secured by polishing because it is due to the metal of the die flowing and condensing under the hobbing pressure.

Vapor Blasting

All hobbed cavities are generally vapor-blasted (Fig. 13) to remove oxidation and discolorations brought about by the annealing operations. This vapor-blasting, sometimes called "liquid honing," is a modified form of impact blasting in which an abrasive, suspended in liquid, is delivered to the blasting nozzle by means of a circulating pump.

Velocity of the liquid honing suspension is imparted by compressed air, normally 90 p.s.i.

With this method the surface of the cavity is given a satin matte finish. Only a light polishing operation is then necessary to restore the desired luster.

Hob Design

In designing a hob that has to be sunk more than 0.500 in., it is best not to have a large or heavy base as shown in Fig. 14. A heavy base will interfere with the closing-in operation necessary to eliminate stretch marks caused by the change in the grain structure after each sinking and annealing.

After the desired depth has been attained, stretch marks are removed by applying pressure on hardened pusher blocks as in Fig. 15. In most cases it is better to make the hob the same size throughout its entire length as needed for the impression.

Very seldom is it practical to use an un-balanced hob as shown in Fig. 16. Hobs of this type have a tendency to bend or break due to the uneven pressure and flow of metal caused by the side angle of the hob. The practical way to produce hobbings or cavities of this type, is to make a balanced double hob (Fig. 17) and then set a hardened plate in the finished double cavity as shown in Fig. 18. In shallow depth hobbings (Fig. 19) it is necessary to have a closing shoulder. This shoulder must always be wider than the final depth of the hobbing. If the shoulder is insufficient it will cause undercuts in the hobbings (Fig. 20).

Conclusion

Don't make the outside dimensions of the cavity any larger than necessary: a 3/8- or 1/2-in. wall thickness is ample for most cavities. Small impressions in large blanks make good hobbing difficult and in most cases impossible.

Selection of hob steel is important. A water hardening tool steel generally does not harden deep enough; oil hardening tool steels are, therefore, recommended for master hobs.

There is more to hobbing than placing the hob on the blank and applying a predetermined amount of pressure. Hobbing requires a lot of experience to solve difficult tasks without prior tests. The real work and art is in producing deep cavities that must have the exact dimensions of the master hob. There is a natural tendency for the metal to flow up and away from the hob. Vertical lines will appear, especially when there are varying steps on the hob. Stretch marks will have to be blended after each annealing.

On one push impressions the amount and location of relief is extremely important. But it is on those impressions requiring two or more squeezes that the hobber's skill and experience really comes into play.

Hobbing is not like a machine tool operation where the work is constantly in view. The results can be seen only when the hob is removed from the impression. It takes only a few seconds in a hydraulic press to ruin a hob on which many hours and dollars have been spent.—END

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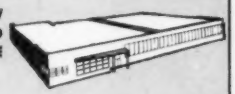

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Extruder Calculation

(*From pp.* 125-127)

sion sections) and a pumping device (metering section). If the extruder does not operate as the metering section calculations predict, it can be expected that the cause of the difficulties will be found in the feed and compression zones.

For example, it may occur that the metering section runs starved because the capacity of the feed and compression zones to deliver melted polymer may be less than the pumping capacity of the metering section. This could happen when an extruder is operated too fast. The melting capacity in certain instances may largely depend upon the heat-transfer capacity of the barrel wall. Higher speeds in these cases will not increase the melting capacity very much, while the pumping capacity of the metering section goes up. As a consequence, the capacity of the feed and compression sections may limit the output of the machine. Under such conditions, surging and uneven extrusion may result. The Simplified Extruder Flow Equation will tell whether the metering section is operating effectively at its proper capacity.

The principal point is that most problems encountered in the operation of extruders will be diagnosed more rapidly, and their true cause will be found with greater certainty, if the performance characteristics which should be expected of the metering zone are known.

Finally, it should be pointed out that the Simplified Extruder Flow Equation represents only one example of the type of calculation which can be carried out to analyze the operation of extruders. Equations for less simplified and consequently more accurate capacity calculations are known. Some of the other factors which can be determined are the heat generated in the metering section and the power consumed by it. Details of this work may be found in the references below.

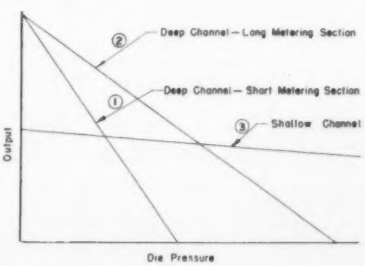

Fig. 5—Metering section characteristics

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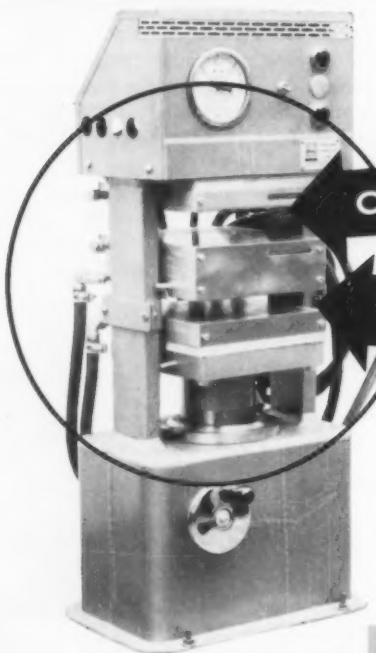

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S.P.E. Conference

(*From pp.* 128-129)

uum forming cellulose acetate, vinyl copolymers, styrene copolymers, acrylics, polyethylene, and nylon. Developments, improvements to come, and a comparison of the methods now in use will be covered as well as the control of heating, forming speed, and cooling for all types of vacuum forming.

Compounding Polyvinyl Chloride Using the Powder-Mix Technique

A. M. Medoro, Jr., Auburn Button Works, Inc., will begin with a historical review of vinyl processing methods and follow with a discussion of the compounding of polyvinyl chloride using the powder mix technique. Mr. Medoro will advise the processor on such points as equipment, material handling, coloring, extrusion, and injection of dry blends.

Plastics for Aircraft Tooling

Benjamin Sokol, Republic Aviation Corp., will discuss the types, comparative tests, typical applications, and probable future scope of plastics in aircraft tooling, with emphasis on glass reinforced laminates and cast epoxy resins. A study will be presented of the effect of time and temperature on the creep resistance of room temperature cured epoxy-glass laminates. Specific formulations of filled resins for various tooling applications will be discussed, as will also the tailoring of resin fillers and catalysts to suit the requirements of a particular job.

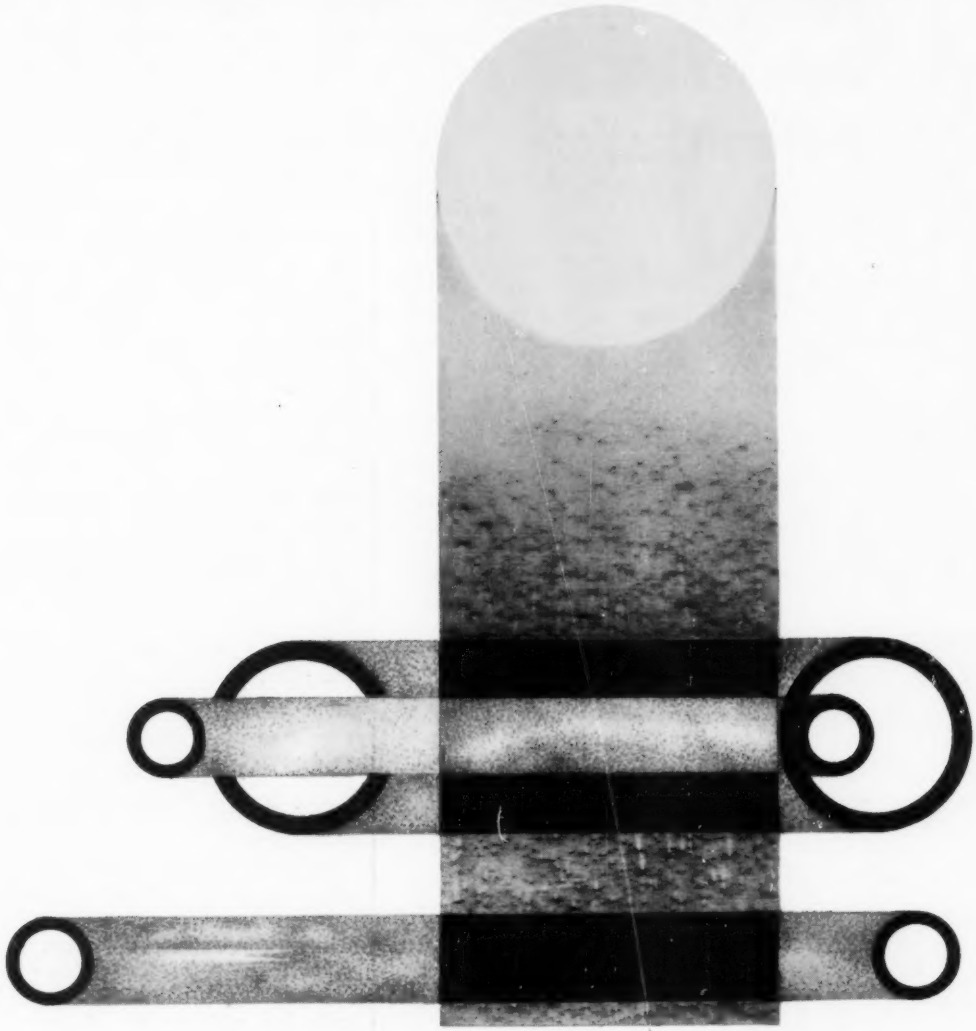
Asbestos-Reinforced Plastic Manufacturing and Design Techniques

W. E. Braham, Zenith Plastics Co., will give the results of pioneering by his company in the development and design of asbestos-reinforced plastics for high-speed aircraft and guided missiles. Because asbestos has greater strength and stiffness than glass fibers, Mr. Braham believes that the development of the asbestos laminating process can greatly assist the Air Force and aircraft industry in meeting the demands of extreme temperatures and stresses.

Molding Granulated Wood

K. H. Brockschmidt, Plastics En-

Why does man use color



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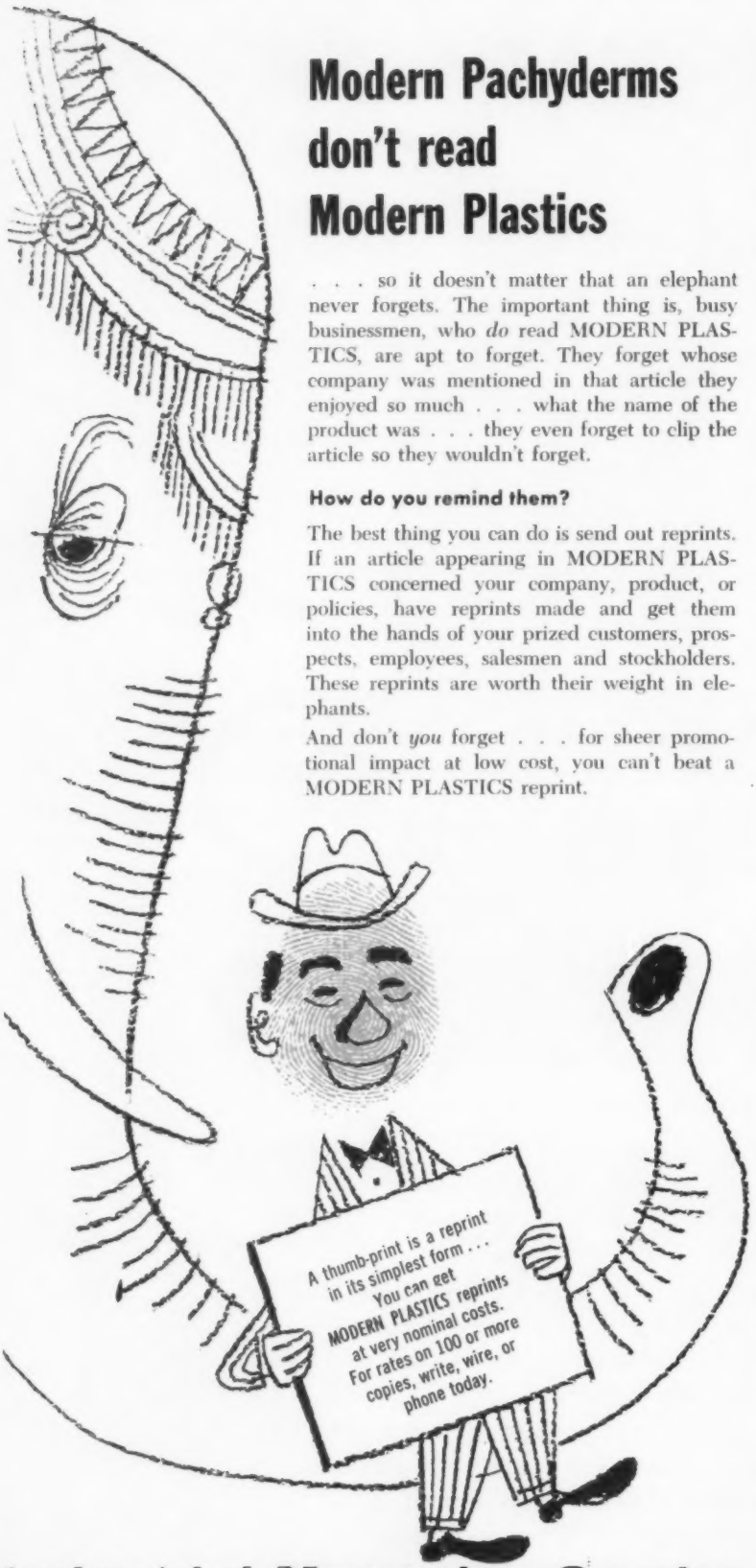
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gineering Co., will show how sawdust, wood flour, fine shavings, etc., with a powdered phenolic resin binder, can be molded to a finished shape in one operation. Utilizing wood-waste in this manner, a high resin content can be used and still be competitive with the least expensive wood products currently on the market.

Paper-Plastic Combinations

V. T. Stannett, New York State University, will briefly describe paper-plastic combinations and will stress the more recent developments. Low permeability of plastic-coated papers to water vapor and other gases will also be discussed in this paper.

Mold Erosion Using Radioactive Tracer Techniques

A. P. Landall, General Electric Co., will describe the way his company attacked the problem of mold erosion by irradiating the sprue bushings of a transfer molding press. Results obtained from this test method may prove useful in developing molding powders with reduced mold wear rates.

Recent Advances With Isocyanate-Base Polymers

Irving Katz, North American Aviation, Inc., will review the developments of isocyanate-base polymers. Their application in elastomers, adhesives, foamed-in-place resins, potting compounds, greases, textile and protective coatings, rocket propellants, heat-resistant plastics, and catalysts will be discussed.

Stock Thermocouples, Pressure Gauges, and Rupture Disks for use on Plastics Extruders

E. C. Bernhardt, Du Pont, will describe thermocouples and pressure equipment. A simple safety device to guard against the build-up of excess pressure in the extruder head will also be described.

Trends in the Plastics Industry

H. W. Zabel, Roger Williams Technical & Economic Services, Inc., will discuss how and why the major type of plastic products manufactured will continue to shift from items with a small unit weight (gadgets) to items that will be large enough so their weight can be measured in pounds.—END

Light Stability

(*From pp.* 131-138)

from the addition of small amounts of cobalt naphthenate and lauryl mercaptan with methyl ethyl ketone peroxide, benzoyl peroxide, or cumene hydroperoxide. However, when the cobalt naphthenate content became appreciable there was noticeable deterioration of light stability.

It has long been known that minute quantities of metallic ions can act as catalysts, activators, inhibitors, or color formers. The effect of such contamination on the color stability of cured panels of IC 312 polyester is shown in Table V, appearing on p. 138.

Metallic ions of cobalt, manganese, and iron were added to the resin as solutions of the naphthenate salts. Tin in the form of stannous chloride was incorporated as a dipropylene glycol solution. The catalyst in all instances was 2% benzoyl peroxide paste (50% benzoyl peroxide dispersed in tricresyl phosphate). Tin had some stabilizing action while the other metals that were tried were found to function in the role of powerful catalysts for the development of color.

Effect of Wavelength

Earlier in this article reference was made to the effect of wavelength of light on the deterioration in color. In Table VI, p. 138, data are given to show the changes resulting from exposure in a Fadeometer of IC 312 polyester when selected filters were employed to screen out the light at various wavelengths. These data show that above a wavelength of 390 millimicrons there was practically no change in color in the specimen even on 1000 hr. exposure, while at lower wavelengths the rate of color change increased as the wavelengths became shorter.

Acknowledgment

The work reported in this article was carried out at the Central Research Laboratories of Interchemical Corp. Acknowledgment is made of the help of A. DiBernardo for the spectrophotometer data and of S. A. Moore, Finishes Division, Interchemical Corp. for invaluable suggestions which were made in the preparation of the manuscript.—END

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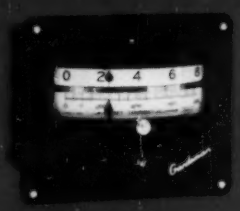

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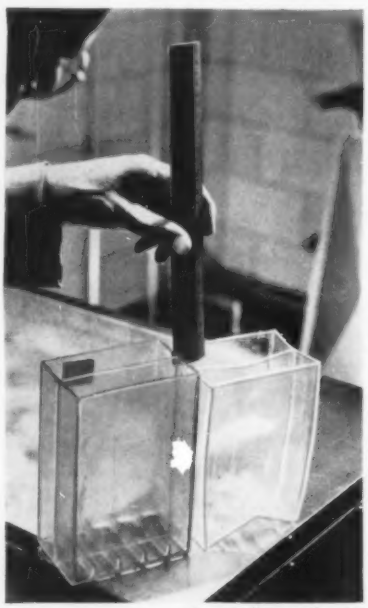
Trends in Styrene

(*From pp.* 154-156)

mers of styrene and methyl methacrylate are readily compounded and cured with rubber into articles of good tensile strength with outstanding flex-cracking fatigue resistance. Block copolymers now prepared show advantages over random polymerization in that the copolymer can be modified without reduction of its softening point and also give us a built-in plasticizer. In the future, such internal modification will lead us to materials with good flow and high heat resistance.

Perhaps the most fascinating study in the copolymer field is the production of clear copolymers. Although



Courtesy Koppers Co., Inc.

Battery cases after 10-min. immersion in boiling water. Case at left was injection molded of heat-resistant styrene; case at right, shrunk and distorted, was made of general-purpose material

some copolymers are clear, a great number are opaque. One reason advanced for this is that the reaction rates of individual monomers differ and, therefore, when two monomers are mixed in any proportion, a copolymer is produced with a wide variation in ratios of reactants and no true solution exists. If this is true, a process could be devised that would add monomers in the ratio and speed at which they are used

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up and thus clear polymer would be produced. This theory has recently been given support; it now remains to prove how well this process can be controlled. Naturally, as the number of reactants increases, this problem becomes more difficult. In the near future, multi-polymers may be produced with crystal clarity as good as present polystyrene.

External Modifications

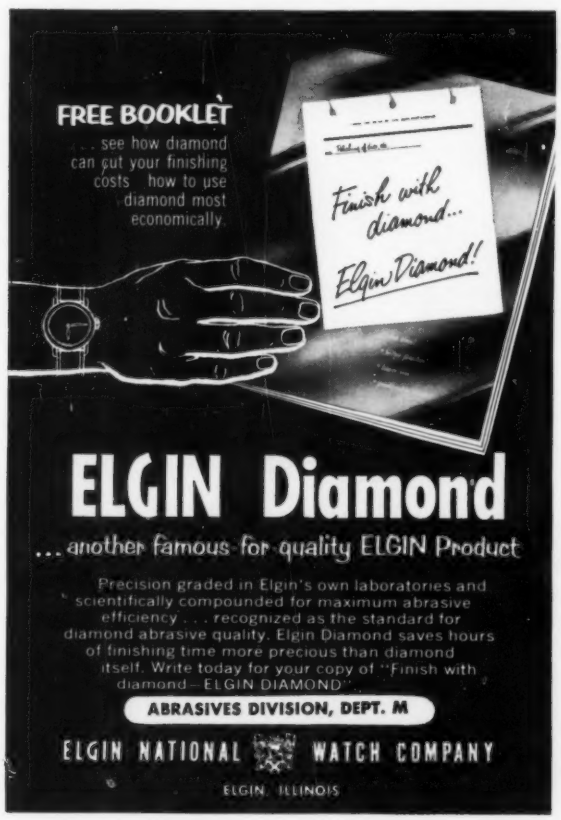
After making these polymers, certain external modifications can be made in subsequent processing. Lubricants that help in molding can be added. A rough rule of thumb expressed by almost all molders is that 25% of injection ram pressure is lost in pushing granules to the spreader because of friction. There are lubricants that can reduce this to 10 percent. Internal lubricants or plasticizers cannot help until some flow starts, so external lubricants are necessary. Higher fatty acids, alcohols, esters, refined stearates, waxes, and silicones are a few of the more promising materials. Care must be exercised in both the amount and type of material since lamination will occur if materials are incompatible. To a molder, reduction in friction is important as it increases machine capacity. If machine capacity is further increased by high flow, without serious loss in properties of molded items, so much the better. Lack of color and haze in the crystal polystyrene are important and selection of lubricant must include this consideration.

A second external modification, which also might be an internal one, is the incorporation of such things as fillers and other resins, such as those containing butadiene, to improve the impact strength of styrene plastics. Fillers as such generally do not add to impact properties, although incorporation sometimes helps in aiding mechanical mixing of ingredients, thereby giving better properties. An exception to this is the use of glass fibers in polystyrene in molding articles of improved impact strength.

Two initial deficiencies of general-purpose polystyrene prominent in consumer use have both been improved separately, namely, 1) brittleness and 2) low heat distortion temperature. There is much evidence that these can be improved at the same time and at a cost attractive to the injection molder. GR-S synthetic rubber is known to possess excellent resiliency and this material has been added to polystyrene to improve impact strength. Initial impact materials of GR-S in polystyrene distorted at temperatures of around 145° F. At this writing, the same materials, now modified, have reached heat distortion temperatures of about 170° F. There is every reason to believe that this upward trend will continue. The incorporation of acrylonitrile can raise the heat distortion temperature up to 210° F., but the price unfortunately is high in relation to general-purpose polystyrene.

The GR-S program has advanced rapidly; yet many of the advances in stabilizers, modifiers, short-stop agents, and ratio of styrene to butadiene must be reviewed in the light of their effect on styrene copolymers and impact materials. In general, two methods of blending polystyrene and GR-S type materials have been used in this work. One method blends them mechanically by such operations as milling, Banbury mix-

(*To page* 239)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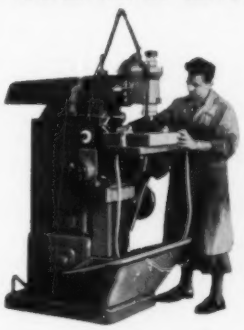

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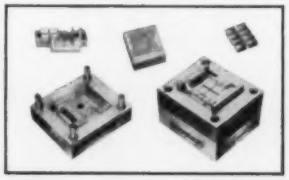

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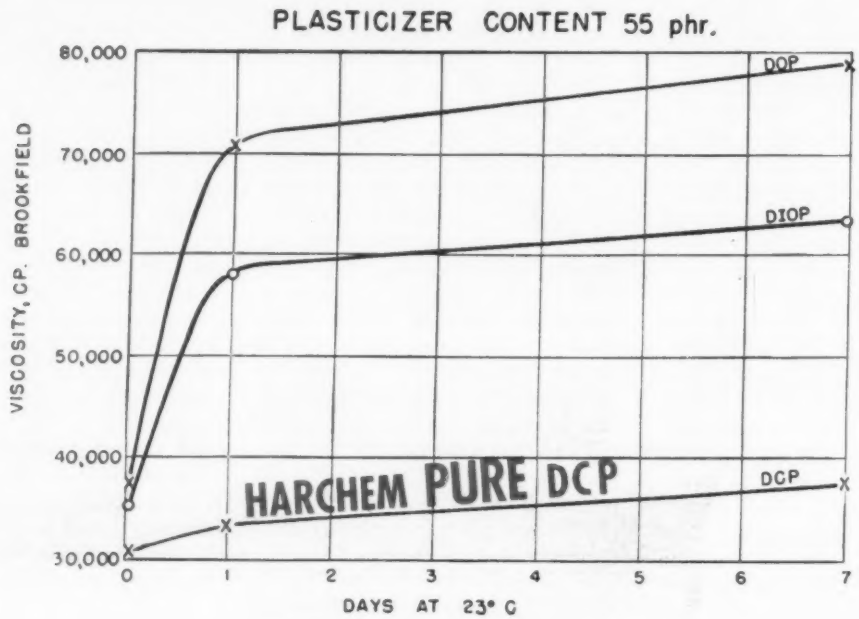

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GLASS LINED STEEL TANK. Bulletin introduces the "Utilitank," a glass lined steel tank for storing resins, plasticizers, stabilizers, and chemicals requiring inert surface for storage. Capacities range from 1000 to 5000 gallons. The Pfaudler Co. **(B-501)**

ABRASIVE-BELT MACHINES. Thirty-two page catalog presents details on ten models of grinding and polishing machines used to perform milling, shaping, planing, filing and many other operations. The Engelberg Huller Co. Inc. **(B-502)**

HOUSE ORGAN. First issue of "Between Ourselves" states magazine's policy and contains facts on company's line of acetate, rigid vinyl, acrylic, and other plastics materials. Almac Plastics, Inc. **(B-503)**

STYRENE ALLOY. Booklet contains application information and engineering data on "Campco" S-300, an alloy of polystyrene and rubber in rigid sheet form. Among its advantages are low cost, fine surface finish, and excellent impact resistance. Chicago Molded Products Corp. **(B-504)**

COLORING PLASTIC FILM. Literature lists and discusses 26 calibrated color pastes for use in producing color controlled vinyl plastic film and sheet. Claremont Pigment Dispersion Corp. **(B-505)**

TUBES FOR HF PLASTICS SEALERS AND HEATERS. Catalog lists the characteristics of various tubes used in electronic sealers and heaters for plastics. Amperex Electronic Corp. **(B-506)**

LEAD SCREW TAPPING HEAD. Data on the new "Auto-Tap" lead screw tapping head, for use with any drill press, for precision tapping in thermoplastic and thermoset materials. Gives specifications of two types, plus their construction features. Automatic Methods, Inc. **(B-507)**

THERMOPLASTIC DRYING OVENS. Fourteen page handbook covers a wide selection of drying ovens, pre-heaters, and annealing tanks for use in working with thermoplastics. Injection Molders Supply Company. **(B-508)**

RIGID PLASTICS PIPE. Leaflet lists the advantages and standard dimensions for the rigid thermoplastic pipe manufactured in regular and extra-heavy weight by Carlon Products Corp. **(B-509)**

TUNGSTEN METALLIZING FILAMENTS. Facts and photos cover a complete line of tungsten filaments used in metallizing molded plastic products. Union City Filament Corp. **(B-510)**

AUTOMATIC COMPRESSION MOLDING MACHINES. Bulletin on Baker fully automatic compression molding machines for high speed molding of small and medium size parts from phenolic, alkyd, urea, "Teflon" and other plastics materials. Baker Brothers, Inc. **(B-511)**

WHEEL DRESSERS. Information on equipment for dressing abrasive wheels used in finishing reinforced plastics, grinding off gates and sprues, and polishing molds. J & S Tool Company, Inc. **(B-512)**

TESTING INSTRUMENTS. Testing instruments for determining weight, bulk or thickness and bursting strength of plastics, metal, fabric, paper, rubber, foil, glass, etc., are described and illustrated in a pamphlet issued by E. J. Cady & Co. **(B-513)**

SURFACE PYROMETERS. Described are various standard, combination, and special models of Cambridge pyrometers. Price list included. Cambridge Instrument Co., Inc. **(B-514)**

ENGRAVING PLASTICS. Brochure describes a hand operated unit that is fitted with different design templates to engrave plastic items such as cigarette cases, tie clasps, compacts, etc. H. P. Preis Engraving Machine Company. **(B-515)**

HIGH FREQUENCY GENERATOR. Details on new high frequency generator which utilizes a circuit that keeps radiation within the assigned 27 megacycle band. Unit complies with F.C.C. code and eliminates need for shielded room. Industron Corp. **(B-516)**

RIGID SHEET POWER CUTTER. Details on compact power cutter for performing a variety of machining operations on rigid plastic sheet, such as beading, folding, nibbling, slotting, etc. Nord International Corporation. **(B-517)**

MILLS. Data on various "Eemco" mills, from laboratory size to 84 inches, for intensive mixing and blending of plastics resins and constituents. Erie Engine Mfg. Co. **(B-518)**

PREFORM OVEN. Literature discusses and illustrates with scale drawings, single and double compartment preform ovens used in the production of fiber reinforced plastic. The Lanly Co. **(B-519)**

PLASTICS MATERIALS. Catalog contains data and price information on sheets, rods, tubes and films made of acrylic, vinyl, polyethylene, fluorocarbons, polystyrene, acetate, nylon and laminated materials. Commercial Plastics and Supply Corp. **(B-520)**

PRODUCTION TAPPING OF SMALL HOLES. Specifications on the Hamilton super-sensitive tapping machine for simple, precision production of small holes in all types of molded and formed plastics. The Hamilton Tool Co. **(B-521)**

POSITIVE CUT-OFF VALVE. Bulletin illustrates and explains the features of a unique rotating disc valve designed to end characteristic dry valve problems usually uncountered in handling powders, pastes and crystals. General Machine Company of New Jersey. **(B-522)**

HOBBING PRESSES. Hand operated and motor driven hobbing presses ranging in capacities from 100 tons up to 2,000 tons are covered in bulletin offered by the M & N Hydraulic Press Company. **(B-523)**

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ROVING CUTTER AND PREFORM MACHINE. Folder contains descriptions and specifications of two new cutters for glass roving. Also lists three preform machines in 28", 40" and 78" models. Turner Machine Co. Inc. **(B-525)**

HEAVY DUTY CRUSHERS. Details on equipment for reducing, by crushing, granular or bulk plastics. Machines are described as being able to handle up to 4 tons per hour and up to 7 inch chunks. Franklin P. Miller & Son, Inc. **(B-526)**

FIBROUS GLASS YARNS. Booklet tells the story of fibrous glass yarns, how they are made, where they are used. Yarn composition table gives specifications, including yards per pound, minimum breaking strength, yarn diameter for 60 different yarns. Libbey-Owens-Ford Glass Company. **(B-527)**

"KELLERFLEX" CARBIDE BURRS. Brochure on high speed carbide burrs of various sizes and designs for performing a wide range of finishing and cutting operations in mold making and general machine work. Includes data on flexible shaft machines. Pratt and Whitney, Div. of Niles-Bement-Pond Co. **(B-528)**

HEAT SEALING PRESS. A 4-post press with bed plates from 16" x 24" up to 48" x 96", which is adaptable to high production heat sealing operations, is discussed in a folder made available by Mayflower Electronic Devices Inc. **(B-529)**

SPRAY PAINTING MASKS AND EQUIPMENT. Data on a process for making "pressure formed" masks for spray decoration of plastics products; on an automatic washer for spray painting masks; and on jigs for holding them. Finish Engineering Co., Inc. **(B-530)**

CUTTING MILLS. Description of cutting mills for reducing thermoplastic materials to granules suitable for extrusion and injection molding. Lists four machines with capacities from 35 to 400 pounds per hour. Condux-Werk. **(B-531)**

STYRENE. Booklet gives information on the manufacture of "Styron" polystyrene, explains the various grades available and tells how polystyrene is employed in the molding of household appliances and accessories. The Dow Chemical Co. **(B-532)**

LITHOPHONE PIGMENTS. Brochure and chart show line of eleven Cadmium Lithophone pigments available for use in manufacturing plastics colorants. Each color is broken down into three shades, and properties chart gives specifications. The Harshaw Chemical Co. **(B-533)**

PLASTICIZER COMPONENT. Literature deals with Dodecenylsuccinic Anhydride which, mixed with sulphur, is useful as a plasticizer in the manufacture of resins, or as plasticizing agents for cellulose compounds. Physical and chemical properties as well as performance charts are included. National Aniline Division, Allied Chemical & Dye Corp. **(B-534)**

PERMANENT NON-ELECTRIC MAGNETS. Bulletin covers the Eriez permanent non-electric grate magnet for removing iron contamination from molding materials. Also gives details of magnets adaptable to any size slope-shaped hopper. Eriez Manufacturing Co. **(B-535)**

"MYLAR" POLYESTER FILM. Technical bulletin covers the physical, chemical, and electrical, properties of "Mylar" polyester film. Suggested applications include electrical insulation, industrial laminates, and special packaging. E. I. du Pont de Nemours & Co., Inc. **(B-536)**

SLOT EXPANDERS. Bulletin explains how company's anti-wrinkle slot expanders are used to eliminate wrinkles from plastics films by applying a smoothing, spreading action during continuous roll operations. Progressive Machine Company, Inc. **(B-537)**

PLASTICS EXTRUSIONS Leaflet on the custom extruding service offered by this company with special emphasis on vinyls. Covers sample making, color matching, quality control and compound development. Vogt Manufacturing Corp. **(B-538)**

TEMPERATURE REGULATOR. Bulletin details the operation of the "Truetemp" temperature regulator. This input controller is added to the controls of any heat processing unit. Built without cams, motors, sliding or manual-adjusting parts. The Winslow Co. **(B-539)**

PLASTICIZER SELECTOR. Circular dial calculator gives performance and compounding data for eleven plasticizers. Enumerates their specifications, physical properties and the performance characteristics of typical specimens made with various formulations. Pittsburgh Coke and Chemical Co. **(B-540)**

DECORATIVE LAMINATES. Information on and illustrations of a line of decorative plastics made by laminating fabrics, Fibreglas, botanical specimens and other items between rigid vinyl sheeting. Pan Laminates, Inc. **(B-541)**

RADIANT HEATING FOR WEBS. Data on the use of "Chromalox" far-infrared radiant panels to pre-heat, cure or dry supported and unsupported plastics film webs. Edwin L. Wiegand Co. **(B-542)**

PLASTICS COLORING. Handy folder lists numerous shades of dry colors for use in coloring plastics. Contains also sundry products of interest to the plastics molder. Smith Chemical & Color Co. **(B-543)**

ORGANIC CHEMICALS. Brochure depicts the various plants and laboratory facilities for the manufacture of organic chemicals operated by Witco Chemical Company. **(B-544)**

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ing, and extrusion. The second is co-precipitation of latices of these materials, followed by drying and forming into granules. The second method is more costly but it gives the better product because of the more intimate mixing. Materials of this nature can reach a notched Izod impact strength of 3.5 ft.-lb./in. of notch. Materials prepared by mechanical processes do not approach this, giving an impact strength of only 1 to 1.2 ft.-lb./in. of notch. However, if the mechanical mixing can be improved, the optimum value to be approached would be that of co-precipitation. Each company employs slightly different methods to get its desired results. Since the number of GR-S type materials is so numerous, variations in end product properties are vast indeed.

Current prices of impact polystyrene ranging in the 30's for various grades are indicative of what the market will bring. Polystyrene has been low-cost material and the molders and end users think in these terms. An impact grade of 1.5 to 2.0 ft.-lb./in. of notch suitable for most items will not command more than a premium of 2 to 3¢/pound and that only if the weld lines in the molded items are of high quality. True copolymers have been around for years; their price is high and, sad to relate, their volume low compared to polystyrene. To appeal to the polystyrene trade the price must be close to polystyrene.

Other properties such as light resistance, oxidation resistance, and chemical resistance can and have been improved. A material with good outdoor qualities is badly needed and probably this will be the next modification to make its appearance, for as the trade demands these items they will hit the market. And as the supply rises, the closer the price of these will approach general-purpose polystyrene.

Molding Practices

The easier flow materials will allow the molding of more intricate pieces with thinner wall sections. This will be accomplished on machines of reduced capacity with ultimate saving in cost of the item. In general, production will go up for existing machines. This is independent of advances that will be made in mold design, mold cooling, and injection machine design which will also advance our industry. The production of food containers and packaging with wall section and cost approaching the presently used cardboard containers may become feasible.

New mold designs that eliminate waste in sprues and runners should produce items with more virgin material. This will tend to upgrade molded products and at the same time reduce cost for the handling of waste material. Certainly, the mold designer has not reached the pinnacle. Hot-runner molds, split feed nozzles, and runnerless molds are now appearing in increasing number.

Research in the injection molding process and understanding of the variables and their relationship to one another is going to improve quality of molded items and allow more intricate and larger pieces to be made while holding dimensional tolerances to a minimum. The culmination of such studies will make molding a science governed by laws giving assurance to our production and a safer, surer road to advancement.—END

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NEWS AND INTERPRETATIONS OF THE NEWS

By R. L. Van Boskirk

Fast-Curing Phenolic

TRADENAMED Durez 17265 Black, a new fast-curing and versatile phenolic compound has been developed by Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y. According to the manufacturer, the thermosetting material is a two-step, wood flour-filled, general-purpose compound with exceptionally fast curing properties.

The molding behavior of Durez 17265 Black is such that a wide variety of articles can be produced either by compression or plunger methods consistent with the characteristics of an extremely fast-curing molding compound.

Reports from trial periods in the field indicate that Durez 17265 preforms quickly and easily. It has a specific gravity of 1.36 and is available in medium to soft plasticities (8 to 12 flow). The material is said to help molders reduce cure time and deliver a fine, glossy surface finish on molded parts. Durez 17265 is reported to be selling at the same price as standard general-purpose materials.

Plasticizer for Records

DESIGNED for use in vinyl compounds for molding conventional and long-playing phonograph records, a new plasticizer, developed by Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y., and called BRC 21 Hydrocarbon, is a reinforcing and extending thermoplastic type.

Barrett states that among the characteristics resulting from the use of BRC 21 are exceptional break and abrasion resistance. It also contributes to fidelity, low surface noise level, and good tonal properties. And since the hydrocarbon itself is black, it confers a smooth, black, glossy surface to the compositions.

The new hydrocarbon disperses readily at temperatures ranging from 200 to 220° F., which provides a short mixing cycle. Compositions containing the plasticizer are characterized at elevated temperatures by rapid flow and sharp definition of mold contour.

Low-Cost Methacrylate Sheet

COMMERCIAL availability of a low-priced cast acrylic sheet has been announced by Rohm & Haas Co., Washington Sq., Philadelphia, Pa. Designated as Plexiglas R, the material ranges from 10 to 25% lower in price, depending upon thicknesses and sizes, than the company's present standard Plexiglas sheet which it will continue to supply.

The manufacturer reports that Plexiglas R is a general-purpose sheet with the same physical and chemical properties as standard Plexiglas, including outdoor weatherability. It is supplied as unmasked, untrimmed material—clear, transparent, and colored—and packaged in standard groupings of sizes and thicknesses.

Because of the lower price, Rohm & Haas expects Plexiglas R to open up new markets for acrylic material. In addition, it is expected to be used for many applications such as signs, industrial glazing, dome skylights, lighting fixtures, and other uses where regular Plexiglas is now the standard material.

Printing on Saran

MEAT PACKERS are showing enthusiasm about a new rotogravure-printed saran wrap for their products. Such products as boneless hams, smoked butts, picnics, bent tip smoked beef tongues, processed meat loaves, and sausage products are being prepackaged in saran.

The new meat wrap was made more applicable by the perfection of the rotogravure printing, slitting, and rewinding of shrinkable-type, single-wound saran film 0.0005 to 0.001 in. thick. Saran film is claimed to be highly economical and completely impervious. It increases shelf life of the product immeasurably and adds to sales appeal because of appearance and the attractiveness of the rotogravure printing.

The material was developed by Printon Corp., 304 E. 23rd St., New York 10, N. Y., in cooperation with The Dow Chemical Co., Midland, Mich.

Irradiated Polyethylene

WHAT is believed to be the first commercial application of irradiated polyethylene has been announced by General Electric Co.'s Chemical Development Dept., which has developed a new form of the irradiated plastic for use as turn insulation on circuit breakers.

G-E Irrathene 201 irradiated polyethylene, a new stabilized type of irradiated polyethylene tape, has been put to use by G-E's Switchgear and Control Div. as turn insulation for blowout coils on its Magne-Blast circuit breakers.

According to Paul Goodwin, supervisor of Irrathene sales development, Irrathene 201 has been stabilized for continuous use at high temperatures ranging from 105 to 125° C., depending upon the nature of the electrical apparatus application.

Another Fluorocarbon

ANNOUNCEMENT of another member of the fluorocarbon family, called Polyfluoron, has been made by Acme Resin Corp., Forest Park, Ill. The new resin is a high molecular weight thermoplastic polymer of chlorotrifluoroethylene.

Polyfluoron has been in continuous pilot plant production since 1950 and is now available either as crystal granules or low-density and micro-atomized powder, as well as a 40% solids dispersion. The material will resist heat up to 400° F. and is unaffected by strong caustics, acids, and oxidizing agents such as fuming nitric acid and aqua regia. Dimensional stability is maintained from −330 to 374° F.

Dispersion coatings of Polyfluoron can be built up quickly and films as thick as 10 mils have been fused in one application without cracking. A primer promotes adhesion on aluminum, steel, and iron and has been successfully used on stainless steel and silver brazing alloy. Polyfluoron

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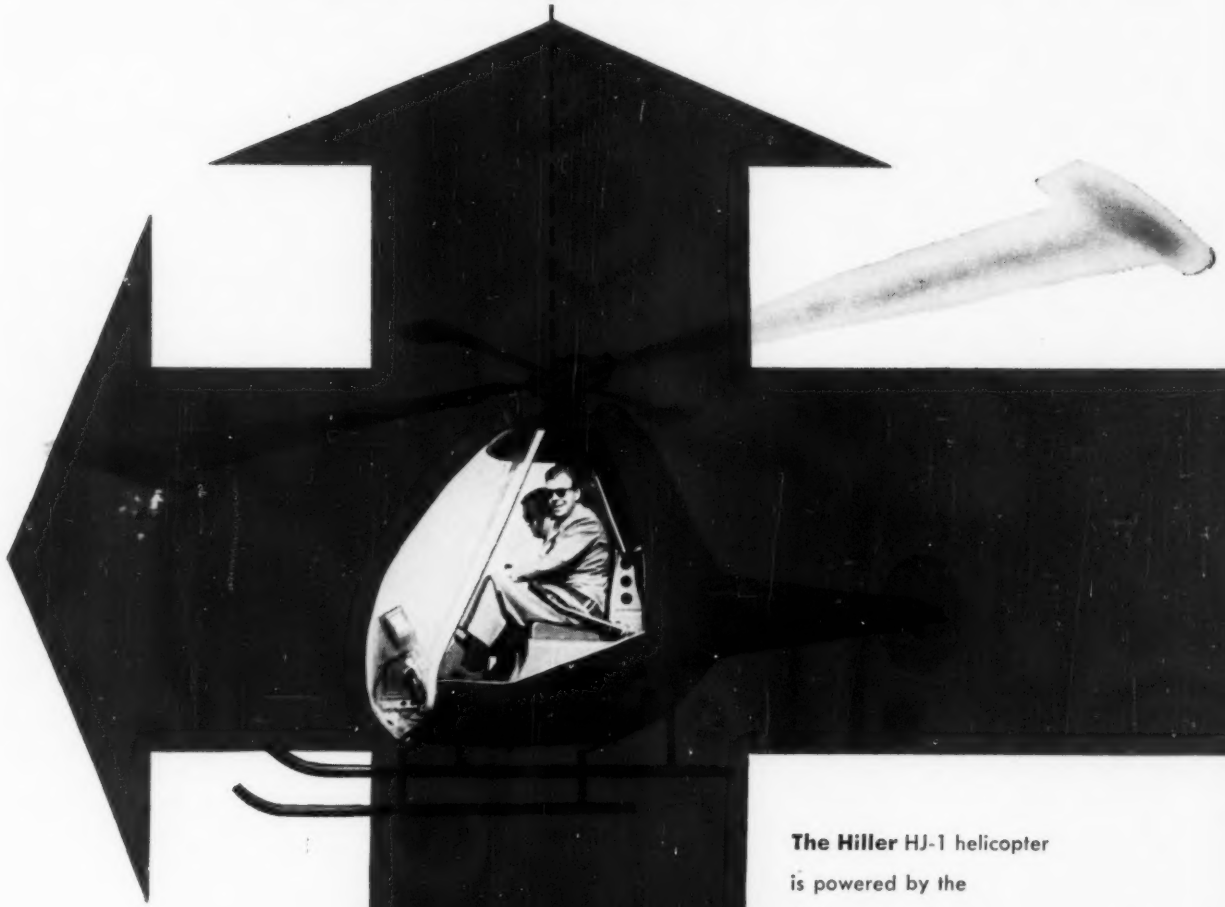

The Hiller HJ-1 helicopter is powered by the first ram jet engine in the U. S. to receive C. A. A. certification. It is notable for its large transparent canopy, with the unusual visibility required for its large variety of missions, including training, liaison, reconnaissance, aerial photography and command. The HJ-I canopy is an outstanding example of the optical perfection of Swedlow-produced components in transparent glazing materials. For specific applications, contact the Swedlow plant nearest you.

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dispersions can be readily cast into films and up to 20-mil film has been successfully made. The molding material can be extruded or molded on conventional thermoplastic molding and extruding machines.

The material is recommended for such uses as in electronic wire insulation for high-temperature operation, radio tube sockets, printed circuits, etc.

The present price per pound ranges from $8.50 for low-density polymer to $10.50 per lb. for dispersion in ton quantities.

Polyfluoron will be sold and serviced in the East by D & R Pilot Plants, Inc., Hazardville, Conn.

Research Editor

JANE F. Winik has been named to the newly created position of research editor of both MODERN PLASTICS and *Modern Packaging* magazines. She will be responsible for the collection of basic market information on all phases of plastics and packaging, including materials, machinery, distribution, and related industries. Mrs. Winik was formerly a senior analyst in the Market Surveys Dept. of General Chemical Div., Allied Chemical & Dye Corp. Her work there included analyses of markets, industrial surveys, and economic studies relating to chemicals and chemical process industries. She is a graduate of Indiana University and has done graduate work at New York University's Graduate School of Business Administration.

New Phthalate Plasticizer

TANK car quantities of Flexol plasticizer 426, a distilled, mixed alcohol phthalate, are now available from Carbide and Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

The new phthalate is claimed to have high solvent power for vinyl chloride resins, is stable to heat and light, and imparts good low-temperature properties to vinyls. It is also compatible with nitrocellulose, chlorinated rubber, and acrylate polymers. Flexol 426 is more volatile than dioctyl phthalate, but it can be used in many products that do not require the performance of premium plasticizers such as the company's Flexol plasticizers D.O.P., 810, or 812.

Prices of Flexol 426 are 27¢ a lb. in tank car quantities, 29¢ a lb. in carload drum lots, and 30¢ a lb. in less than carload drum lots.

The company also announces that the prices of Flexol plasticizer CC-55, suggested particularly for plastisols where it helps to produce low-viscosity plastisols of great viscosity stability, have been reduced as follows: Tank car lots now sell for 30½¢ a lb.; carload and truckload lots in drums, 32½¢ a lb.; and less than carload drum lots, 33½¢ a pound.

Styrene Monomer Price Reductions

COMPANIES producing styrene monomer have reduced their synthetic rubber grade to 18¢ per lb. in tank car lots. This is the type of monomer the Government has been buying at about this price for a long time.

The synthetic rubber grade monomer is usable not only for rubber in tires, rubber soles and heels, but also in styrene-butadiene latices for paper, textiles, paint, floor tile, and in the polyester and alkyd fields.

The monomer will have a minimum styrene content of 99% and not more than 0.020% sulfur content. Monomer of this purity is believed to be entirely satisfactory in all applications, except in the production of polystyrene. The price of the monomer for polystyrene has not been reduced.

Ceiling Panels

PLASTICS panels for translucent ceiling installations have been introduced into its line of construction panels by The Celotex Corp., 120 So. La Salle St., Chicago 3, Ill.

The 24- by 24-in. Lumicel panels are made of white vinyl copolymer and are installed by means of a metal suspension system. They are treated with an anti-static coating so that dust doesn't collect on the surface but, when cleaning does become necessary, the panels can be removed, washed, and replaced.

Where sound absorption is also required, Acousti-Lux, which is a pair of translucent plastic panels welded together at their perimeters, is being promoted. It is stated that the diaphragmatic action of the air space between the panels absorbs sound.

Truck Show

THE following items were recently displayed at a Plastic Truck Show sponsored by Celanese Central Research Laboratory, Summit, N. J.:

A single-piece plastic milk tank trailer approximately 27 ft. long, 58 in. high, and weighing 7000 pounds. Three of these trucks are now operated by the Dairymen's League Co-operative Assoc., Inc.

A farm pick-up truck with sanitary rear compartments to meet all health standards. Lightweight plastic doors are molded to accommodate the latest type of one-piece, snap-on, sanitary gasket which assures a positive seal.

An insulated chemical tank made up of a shell (inner tank) and a jacket (outer tank), weighing 7600 lb., and with a capacity of 3750 gallons.

A panel delivery truck used by bakeries, dairies, etc. One of these trucks is reported to have recently turned over three times without apparent damage to the truck and with only minor injuries to the driver.

A semi-trailer van, the first plastic truck specifically designed for the transportation of textiles, approximately 33 ft. long, 8 ft. wide, and 12 ft. 6 in. high. To improve visibility for reading labels and loading lists, two translucent roof panels of unpigmented resin were provided.

A scooter now being tested by the Dept. of the Army, Bureau of Ordnance; over 300 are on trial by the Post Office Department. The reinforced polyester cargo box has a ¼-ton capacity.

The bodies and various other components of the above vehicles were made of reinforced plastics, using Celanese Marco and other polyester resins. The milk tank trailer and farm pick-up truck were built by Heil Co., Milwaukee, Wis., and produced by the Heil Frigid-Lite plastic method; the insulated chemical tank was built by Carl N. Beetle Co., Fall River, Mass., to be used by T. I.

HOUSINGS ARE 1/2 ACTUAL SIZE

Not since 1937—thanks to PLASKON® Urea

For almost 20 years the Rochester Germicide Company has used PLASKON Urea Molding Compound to make the housing for its Sanor deodorizing device, as illustrated above. This material has proved to be so completely satisfactory that Mr. W. B. Eddy, president, says: "Since switching from expensive cast iron in 1937, we have never used *anything but* PLASKON Urea!"

Why the great enthusiasm for this plastic material? Because its attractive, hard surface has a glossy finish that's tough to scratch and easy to clean. Furthermore, it molds easily, fuses rapidly, has excellent flow characteristics and cure properties.

This combination of qualities has made PLASKON Urea Molding Compounds a *must* with manufacturers of a wide range of products. Isn't it possible that one of *your* products could be made *better* with a PLASKON Plastic or Resin? Why not find out for yourself! Write or call today for complete information.

Barrett PLASKON

For further information on PLASKON Plastics and Resins, address BARRETT DIVISION, Allied Chemical & Dye Corporation, 40 Rector Street, New York 6, N. Y. Phone HAnover 2-7300

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McCormack Trucking Co., Inc.; the panel delivery truck was built by General Body Mfg. Co., Kansas City, Mo.; the semi-trailer van was built by Strick Co., Philadelphia, Pa.; and the scooter was built by General Body Mfg. Co. for Cushman Motor Works, Lincoln, Nebraska.

Ciba Price Reductions

REDUCTIONS in the cost of its Araldite liquid epoxy resins have been announced by the Plastics Div., Ciba Co., Inc., 627 Greenwich St., New York 14, N. Y., as follows:

Three formulations have been reduced from 90½¢ a lb. in carload quantities to 80¢ a lb.; Araldite 6030 and 6040 have been cut from 90½ to 85½¢ a lb.; and Araldite 504, from 90½ to 77¢ a lb. in carload quantities.

The company also announces the introduction of a plasticizer for epoxy resins and two new liquid epoxy resins—Plasticizer I, Araldite 6010, and Araldite 6040.

Plasticizer I, the first in a new series, is a specially designed internal plasticizer which reacts with the resin and eliminates the problem of leaching. It will sell for 72¢ a lb. in carload quantities. Araldite 6010 is a lower-viscosity resin than has been previously offered. Araldite 6040 is a very high-viscosity liquid resin.

Hercules Consolidates Plants

TWO of its facilities have been consolidated at Hopewell, Va., according to an announcement by Hercules Powder Co., Inc., Wilmington, Del. Formerly operated as separate units by two independent company departments, the combined plant will now be operated by the Virginia Cellulose Dept. Floyd L. Boddicker has been named manager of the combined plant.

Hercules also announces that manufacture and research, involving C.M.C. (sodium carboxymethylcellulose) and ethyl cellulose, will be handled by the Virginia Cellulose Dept. The sale of C.M.C. will continue to be handled by Virginia Cellulose, and ethyl cellulose by the Cellulose Products Dept.

One of the two plant units at Hopewell has been used by Hercules since 1926 for the production of chemical cotton, a very pure form of cellulose made from cotton linters. Chemical cotton is used in many industries, including plastics, rayon, explosives, photographic film, lacquer, and paper manufacture.

The second plant unit, built in 1939 and expanded twice since that time, is used by the company for the production of ethyl cellulose and C.M.C. These products are used for the production of plastics, paints, varnishes, lacquers, pharmaceuticals, laundry products, paper, printing inks, adhesives, and by the oil industry.

The combined plant employs more than 1200 personnel.

Polyethylene Pipe Standards

COMMERCIAL Standard for Dimensions and Tolerances for Flexible Standard Wall Polyethylene Pipe, CS197-54, is now available, according to an announcement by Commodity Standards Div., United States Department of Commerce. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 5¢ each.

The Commercial Standard was established at the request of The Society of the Plastics Industry, Inc. It establishes dimensions and tolerances for inside diameters and wall thicknesses of 10 nominal sizes of flexible polyethylene pipe, ranging from ½ to 6 in. in diameter. The Commercial Standard also establishes minimum weights in pounds per 100 ft. of pipe. Methods of sampling and test procedures, as well as a recommended method of labeling pipe that is in accordance with the Commercial Standard, are included.

Licenses Elastomer Process

ACCORDING to The Girdler Co., 224 E. Broadway, Louisville 1, Ky., the company is now exclusive licensor of the Elastomer process in all foreign countries, except Canada.

The Elastomer process employs inert gas as a foaming agent in the production of foam vinyl from resin-based plastisols. Foam vinyl, made with this new process, is expected to compete with foam and sponge rubber on a price and quality basis.

In the United States, it is reported that several rubber companies and vinyl processors are planning to produce foam vinyl on a commercial scale. They have acquired licenses for the Elastomer process and are presently installing pilot plant or production equipment.

A.C.S. Plastics Meeting

SUBJECTS for the meeting of the Paint, Plastics, and Printing Ink Chemistry Div. of the American Chemical Society, which meets in Cincinnati, Ohio, April 4 to 7, have been announced as "Cure in Thermosetting Resins," "Adhesion," and "Taste and Odor Aspects of Paints, Plastics and Printing Inks."

Prematched Colors

STANDARD prematched pastes in the D-1000 series are currently being supplied to molders of vinyl footwear by Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn 11, N. Y. Among the colors available are red, brown, tan, and white.

The company states that production runs utilizing these products in plastisol formulations have proved them stable to curing temperatures ranging from 350 to 600° F. Colors perform satisfactorily in foam compounds under similar conditions. Pastes are smoothly and easily incorporated into plastisols by conventional methods during or after compounding.

Vinyl Fashion Show

FIRST fashion show devoted exclusively to vinyl ready-to-wear was conducted by Harte & Co., Inc., 16 E. 34th St., New York, N. Y. All exhibits were made from Harte-produced vinyl fabric. Fred S. Strauss, president, states that his company has been working toward this goal to meet the requirements of the clothing manufacturers which his company supplies.

The style show emphasized particularly the entrance of vinyl into the fashion field. Featured in this classification are vinyl products made to simulate leather or to provide a unique fabric.

Mr. Strauss states that the "prices of clothing produced from vinyl are so reasonable that the usual sales resistance to children's clothing has

NEW! Colorful Plastainer Vials BY OWENS-ILLINOIS

Plastainer vials are now available in a wide variety of attractive colors, opaque and transparent, with colorful matching closures. They are typical examples of the many sizes, shapes and colors of containers the broad plastic molding facilities of Owens-Illinois make possible to fill your needs.

You can package anything from candy beads to fishing tackle in Plastainer vials by Owens-Illinois. They protect contents from handling, air and moisture until used. Plastainer vials won't split or crack . . . have wide diameter for easy filling and stable base . . . come in 6 sizes: 3 to 15 drams.

Owens-Illinois packaging know-how and high-quality standards offer you the finest in plastic molding facilities . . . Injection molding . . . Compression molding . . . A complete range in plastics for packaging, for specialties.

Branch Offices:

Albany . . . . . New York	Columbus . . . . . Ohio	Memphis . . . . . Tennessee	Pittsburgh . . . . . Pennsylvania
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Baltimore . . . . . Maryland	Denver . . . . . Colorado	Nashville . . . . . Tennessee	Richmond . . . . . Virginia
Birmingham . . . . . Alabama	Detroit . . . . . Michigan	New Orleans . . . . . Louisiana	Rochester . . . . . New York
Boston . . . . . Massachusetts	Fresno . . . . . California	New York . . . . . New York	St. Louis . . . . . Missouri
Buffalo . . . . . New York	Houston . . . . . Texas	Oakland . . . . . California	St. Paul . . . . . Minnesota
Charleston . . . . . West Virginia	Indianapolis . . . . . Indiana	Oklahoma City . . . . . Oklahoma	Salt Lake City . . . . . Utah
Charlotte . . . . . North Carolina	Jacksonville . . . . . Florida	Omaha . . . . . Nebraska	San Francisco . . . . . California
Chicago . . . . . Illinois	Kansas City . . . . . Missouri	Peoria . . . . . Illinois	Seattle . . . . . Washington
Cincinnati . . . . . Ohio	Los Angeles . . . . . California	Philadelphia . . . . . Pennsylvania	Toledo . . . . . Ohio
Cleveland . . . . . Ohio	Louisville . . . . . Kentucky		

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been broken—the problem of children growing out of their clothing or tearing their new garments the same day they have been put on has been pretty well met by vinyl ready-to-wear."

Harte & Co., whose tradename for its vinyl material is Wataseal, also announced the production of Hartex, a pressure-sensitive vinyl wall covering that is particularly adaptable for the do-it-yourself market. It needs no water or paste and will adhere to paint, glass, wood, and to almost any flat, dry, clean surface. It is 18 in. wide and will sell for about 59¢ a yard.

British Plastics Exhibition

BRITISH plastics manufacturers, with an output in 1954 nearly 30% above the previous year's figure and exports 25% up, have over-applied for space in the third biennial British Plastics Exhibition to be held June 1 to 11, 1955, in Olympia, London, England.

A new exhibit will be a display of chemicals, molding materials, and moldings shown by the Canadian Government as an example of plastics development in the Commonwealth.

Small-Lot Moldings

MOLDS for short runs in either thermoplastic or thermosetting materials and molds in which exact reproductions can be made for test purposes are being offered by Dayton Rogers Mfg. Co., Minneapolis 7, Minn.

The company claims that its molds are particularly practical where cost of conventional-type tooling would be prohibitive. These short run molds reduce cost to about 15 to 25% of that of conventional molds, according to company spokesmen.

Fiberite Phenolic

ANNOUNCEMENT of a plastic that is said to possess extremely high flexural and impact strength has been made by Fiberite Corp., Winona, Minn.

Identified as FM 11679 Black, the new plastic is a two-step cord-filled phenolic molding material with a minimum flexural strength of 18,000 p.s.i. and a minimum Izod impact strength of 14 ft.-lb./in. of notch, according to the manufacturer's mechanical tests.

Other properties of FM 11679 Black include a plasticity that is medium to hard; a heat resistance of molded parts up to 250° F., and a compressive strength of 18,000 p.s.i.

Further information and samples may be obtained from the company.

Chemical for Heat Resistance

PUBLICATION of a technical bulletin on dihydroxy diphenyl sulfone (D.D.S.), a chemical which shows promise as an ingredient in the production of heat-resistant epoxy and phenolic resins, has been announced by Monsanto Chemical Co.'s Organic Chemicals Div., St. Louis 4, Mo.

Commercial quantities of D.D.S. are now available from Monsanto. The chemical has been used primarily as an additive in electroplating baths and is also claimed to be useful as an intermediate in organic synthesis, particularly when compounds stable to the oxidizing action of light and air would be valuable.

Several of the important D.D.S. reactions, keyed to an extensive bibliography, are diagrammed in the bulletin.

Plastics College Course

TWO new courses on plastics, which will be the nucleus of a 3-yr. certificate program for personnel in the plastics industry, has been announced by the Special Courses Div. of Newark College of Engineering, 367 High St., Newark 2, N. J.

Milton A. Sanders, project engineer of Sun Tube Corp., Hillside, N. J., and John Lombardi, plant superintendent of Shaw Insulator Co., Irvington, N. J., have been appointed to conduct the courses. Mr. Sanders will conduct a course on injection molding and Mr. Lombardi will teach a companion course on compression molding.

Joseph Bonnano, president of the Newark section of S.P.E., which is cooperating with N.C.E. in the program, states that the demand for trained workers in this field is so great that the series is expected to have a heavy enrollment from the start.

Beginning in September 1955, the college plans to offer eight more courses to bring a complete survey of modern techniques and methods to workers in the industry. The series is being organized by Achille Capecelatro, executive associate of the N.C.E. department of Physics.

British Plastics Exports

THE British plastics industry has had a record export year for plastics materials in 1954, according to British Plastics Federation, London, England.

Exports for the first 10 months of 1954 amounted to approximately $48,700,000 or some $2,325,000 more than the value (over $45,375,000) for the whole of 1953, when exports reached their previous highest level.

These statistics cover such items as molding powders, resins, sheet, tube, rod, and foil, but exclude manufactured articles and parts.

World's Fair

A COMBINATION trade and consumer exhibit—World Plastics Fair and Trade Exposition—will be held April 6 to 10, 1955 in the National Guard Armory, Figueroa and Exposition Sts., Los Angeles, Calif. Theme of the show will be "Plastics—from Research to Production to Better Living."

The show is open to engineers, executives, and industrial designers through passes obtainable from exhibitors or the show management. Consumers will be permitted to attend only during the two closing days and the evenings.

Copies of a brochure and fact sheet regarding the fair may be obtained from Exposition Management, World Plastics Fair and Trade Exposition, 8762 Holloway Dr., Los Angeles.

Color for Latex

DEVELOPMENT of a new line of Stir-In pulp colors recommended for use in latex emulsion paints of all types has been announced by The Sherwin-Williams Co.'s Pigment, Color & Chemical Div., 300 W. Lake St., Chicago 6, Ill.

These pulp colors are said to be of homogenous mixtures of pigment and water which will not settle out

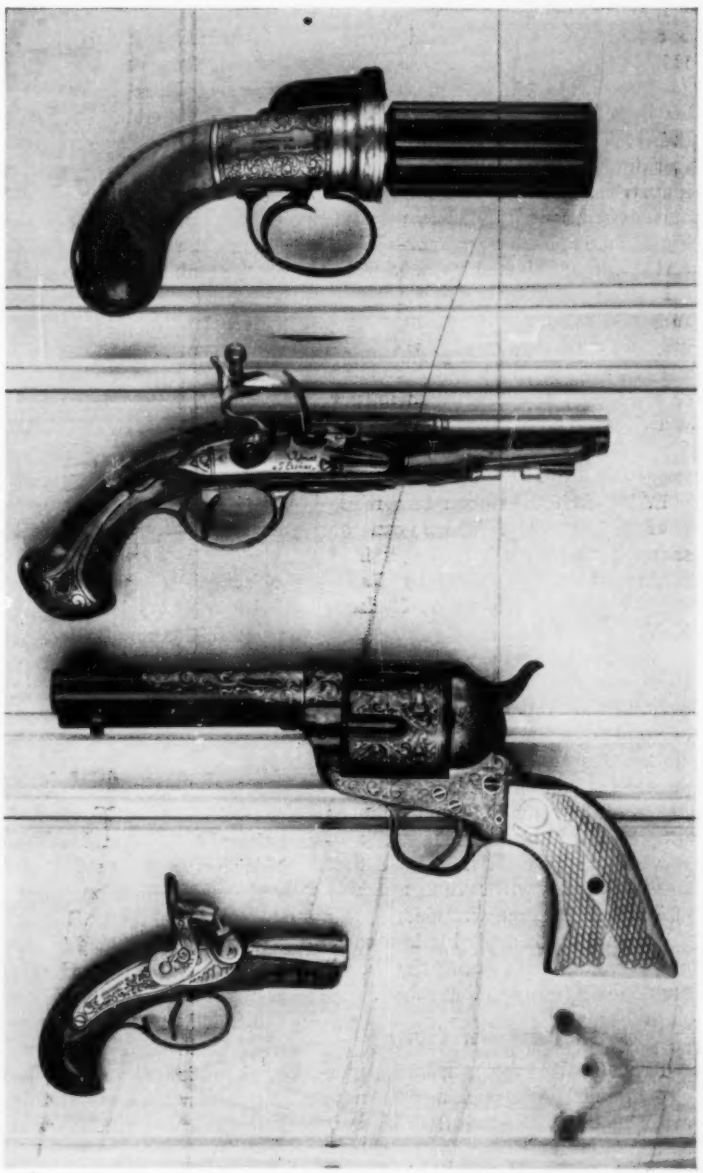
STYRON 475 . . . gives flawless reproduction at surprisingly low cost!

This DOW plastic reproduces "famous firearms", a Kellogg premium, in amazingly accurate detail . . . offers wonderful opportunities for other low-cost premium ideas.

Now you can offer manufacturers authentic reproductions of trademarks or models for fast-selling, low-cost premiums. Styron's ease of formability opens the way to design reproduction that's realistic right down to the last detail, while its wide color selection enables you to match original colors closely.

Premiums made with Styron® 475 *stay* attractive and eye-appealing, too, because this plastic is tough, strong, has built-in color that won't chip, fade or peel.

Styron 475 combined with new molding techniques brings smooth, fast production at very low cost. Why not take advantage of its many outstanding properties to capture your share of the rich premium field. For further information, write to Dow Plastics Sales Department PL 452X. THE DOW CHEMICAL COMPANY, Midland, Michigan.



Some of the "famous firearms" premium molded for Kellogg . . . the Colt 45, the Derringer and the Pepperbox Pistol. Note the intricate detail possible with Styron 475.

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DOW

THE PLASTISCOPE

during normal storage. They are designed for cases where it is desired to save the cost of grinding the pigment or where grinding facilities are not available.

Polyvinyl Acetate Emulsion

PRODUCTION of a new polyvinyl acetate emulsion, called Nopco 1572-R, has been announced by Nopco Chemical Co., Harrison, N. J. It is a versatile resin emulsion for use in the paper, textile, cement, woodworking, leather, ceramics, and glass industries, and functions as an important component in the compounding of paints, such as primer-sealers and exterior paints for masonry.

Nopco 1572-R is the first product to come from the company's new polymerization unit at its Cedartown, Ga., plant. The unit is capable of producing several million lb. per year.

Vinyl Ribbon

READY-MADE ribbon-ties made of Krene vinyl which can be snapped around gift packages in 5 sec. are being produced by Rapid Ribbon Corp., Croton-on-Hudson, N. Y.

The elastic memory of vinyl allows considerable stretch and yet permits the ribbon to return to its original size and shape. Low-cost ribbon-ties to fit a wide range of package sizes eliminates cutting, tying, and bow-making and reduces the time it takes a sales clerk to serve a customer. It is claimed that the ribbon-ties will save as much as 40 sec. per package wrapped.

The product is available in a variety of colors with decorative bows, heat-sealed firmly to the ribbon.

Plastic Container Covers

STYRENE lids for standard paper containers are opening up new areas in the packaging field as well as bringing about another combination use of materials. Two such lids have recently been announced, one injection molded and the other vacuum formed from oriented sheet stock.

The vacuum formed lids are being offered to the trade by Dixie Cup Co., for use with 8-, 12-, and 16-oz. containers. The lids, developed by Plax Corp., Hartford, Conn., are made from 10-mil Polyflex polystyrene sheeting. The material is odorless and imparts no taste to food; it is also dimensionally stable and, because it is transparent, permits a clear view of the package content. It is reported that the lids are satisfactory for use at temperatures found in home and store freezers and will withstand the heats used in packaging foods in wax containers. The Dixie lid forms a primary seal with the bead of the cup and has an overlap to produce a sanitary seal. The finished caps have a high gloss, can be embossed during the forming operation, and can be printed by conventional process or hot stamped.

The new injection molded lid is being produced by Auburn Button Works, Auburn, N. Y., and was designed especially for Sealright's Nestyle 12- and 16-oz. containers. A part of the Sealright line of containers is made of vinyl-coated paper. If desired, heat-sealed labels can be applied to the styrene lids which will withstand moisture, heat, and cold.

An added advantage of plastic covered containers is their reuse value for storing leftover foods, packing foods for home freezers, and for storing screws, nails, and other hardware in the home workshop.

Refinanced Fabricator

STOCKHOLDERS of E. L. Cournand & Co., Inc., Havre de Grace, Md., have approved a refinancing and recapitalization plan effected through Lehman Brothers, New York investment banking house.

Under the approved program, the name has been changed to Luria-Cournand, Inc. A management contract to direct the company's affairs has been issued to Luria Engineering Co. of New York and Bethlehem, Pa., a designer and producer of standardized steel industrial buildings, airplane hangars, and airport facilities.

Luria-Cournand, Inc. will establish executive and sales offices at 511 Fifth Ave., New York, N. Y., and continue to operate an expanded plant at Havre de Grace, about 30 miles north of Baltimore. Under its previous ownership and management, the 12-yr. old company manufactured a wide variety of structural plastics for defense and industrial purposes. Present plans call for a continuation of such production on an enlarged scale.

The original concern was founded by Mr. Cournand in 1942 to produce transparent plastic canopies and gun enclosures for fighter aircraft. Among other structural plastic products manufactured by the company are bonded structures, missile containers, multi-purpose shelters for radar, and similar equipment and various types of water tanks.

Microballoons

MICROSCOPIC spheres of phenolic resin are expected to save the petroleum industry as much as $60 million annually because these little phenolic spheres can effect an 80 to 90% reduction in evaporation loss from crude oil storage tanks.

Bakelite Co. has appointed Chicago Bridge & Iron Co., Chicago, Ill., distributor of its balloons. Fred L. Goldsby, vice president and general sales manager of Chicago Bridge & Iron, estimates that about 1.25 out of every hundred barrels of crude oil in cone roof tank storage evaporate annually and blow away. Tests indicate that microballoons will cut losses to about ¼ barrel per hundred.

Correction

THERE were two errors in the January MODERN PLASTICS review. On page 80 in the section on vinyl chloride, the amount of domestically produced solid resin consumed in the United States was listed as 386 million pounds. Attention should be called to the fact that this figure represents both domestic and foreign resin used in the United States. The domestically produced portion was approximately 375 million pounds.

The second error was in the section on cellulosics on page 75. The price per pound for Group III opaque materials was listed as 41 cents. It was reduced to 35¢ the day this magazine went to press.

EXPANSION

Pittsburgh Plate Glass Co. announces the opening of a new building in Springdale, Pa., to house the basic and applied research labora-

Monsanto

SHOTS

◊ Marked samples of Lustrex Hi-Test 88 styrene, prior to testing on Baldwin-Southwark Universal machine.

◊ Elongation test in progress. Total elongation value of 28% was recorded for Lustrex Hi-Test 88.

Lustrex Hi-Test 88 is tough!

Elongation test proves amazing ductility of Monsanto's high impact styrene!

By submitting sample bars of plastic materials to a terrific tug-of-war, the Baldwin-Southwark Universal Tester can measure their elongation values.

In these punishing tests, sample bars of Lustrex Hi-Test 88 styrene achieved a total elongation value of 28%.

This phenomenal ductility is 30% greater than other leading high-impact materials tested—and from 10 to 15 times greater than general purpose styrene.

Lustrex Hi-Test 88 has other outstanding toughness features. It offers impact resistance up to 500% higher —and flexural fatigue values that are 15 times greater than unmodified styrene compounds.

You also get superior moldability and flow when you use Lustrex Hi-Test 88. Surface gloss and color stability are excellent. Suitable for injection and compression molding, extrusion and vacuum-forming.

For proof that Monsanto's high impact styrene can improve the quality and sales appeal on the products you mold, try Lustrex Hi-Test 88 on your next job. Write Monsanto Chemical Company, Plastics Division, Dept. MP-2, Springfield 2, Mass.

For superior toughness, specify **HI-TEST 88**

MONSANTO

LUSTREX Styrene Plastic

tories for the company's Paint and Brush Div. Prior to construction of the Springdale laboratory, Pittsburgh Plate's basic and applied paint and plastics research facilities were located in Milwaukee, Wis.

The new laboratory will be devoted to the creation and experimental production of new chemical compounds, paints, varnishes, enamels and lacquers, resins, and plastics.

Headed by **Dr. Howard Gerhart**, the research laboratory currently has a staff of 85 chemists, engineers, and assistants. One wing of the building is reserved for teams of specialists in high polymer chemistry whose function is to develop new chemical compounds for synthetic resins.

Minnesota Plastics Corp., 45 W. Maryland Ave., St. Paul 3, Minn., recently observed the 15th anniversary of its founding, shortly after the formal opening of the company's new $1¼ million plant, in which an area of 95,000 sq. ft. marks an increase of 40,000 ft. over the previous production facilities.

Devoted completely to thermoplastic molding, the new plant includes 25 injection machines ranging in capacity from 4 to 80 oz., along with the most modern assembly facilities, paint department, tool room, and warehouse and loading areas. The molding room is designed with ample space between presses to facilitate production and movement of finished parts. Provision is made for material storage directly adjacent to each press.

Officials of the company, a major producer of refrigeration components and other types of industrial parts, include **H. R. Galloway**, president and treasurer; **C. S. Blackwell**, vice president; **R. J. Busek**, secretary and purchasing agent; **J. H. Thomas**, sales manager; and **J. J. Brandt**, chief engineer.

Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y., has broken ground for the construction of a new building in Belvidere, N. J., for the production of continuous-length plastic sheeting. The building, which will comprise an area of approximately 300 by 60 ft., is scheduled to be in operation at the end of 1955.

The company states that the expansion will widen the scope of its Belvidere operations by giving the unit a fourth line of plastics products. At present the plant produces continuous-length film, molding powder, and polyethylene film.

Angier Products, Inc., Cambridge, Mass., manufacturers of industrial adhesives and cements, has established a new western division in Huntington, Ind. All home-plant facilities have been duplicated at the new branch, including every phase of research, product control, and volume production.

John Kerr has been named manager of the sales office of the new division and **Henry Klos**, plant superintendent.

Frank W. Egan & Co., designers and builders of machinery for the paper converting and plastics industries, has broken ground for a new plant near Somerville, N. J., about four miles from its present works in Bound Brook, N. J.

The new facilities will provide 14,000 sq. ft. for office space, shop, erection bay, and laboratory.

COMPANY NOTES

Du Pont's Rubber Chemicals Div., Wilmington, Del., has formed a new sales organization to handle the growing market for polyisocyanates. **William H. Ayscue**, formerly assistant sales manager of rubber chemicals, has been named manager of the new unit and **Dr. Charles J. Harrington**, formerly an assistant secretary of the company, has become assistant manager.

Mobay Chemical Co., 1700 S. 2nd St., St. Louis 4, Mo., jointly owned by **Monsanto Chemical Co.** and **Farbenfabriken Bayer, AG.**, announces the following appointments: **Dr. Samuel Steingiser** has been named head of the testing group of the company's research department. Mr. Steingiser has been a group leader of Monsanto's Chemical Research Dept. in Dayton, Ohio. Until Mobay's new research facilities are completed in New Martinsville, W. Va., Mr. Steingiser will maintain his headquarters at Monsanto's laboratories in Dayton. **Herman N. Woebcke** has been appointed chief engineer of Mobay. **Phillip A. Sanguinetti** and **Herbert L. Heiss**, both of Anniston, Ala., have been made group leaders in Mobay's research department. Mr. Sanguinetti will head the research department product and equipment demonstration group, now being established in St. Louis. Mr. Heiss will be in charge of a group investigating the application of isocyanates in the coatings, rubber, and adhesives fields.

Union Carbide and Carbon Corp. announces that after a number of years with offices in five different buildings, the firm has consolidated its Cleveland offices in a new office building and distributing center at 1300 Lakeside Ave.

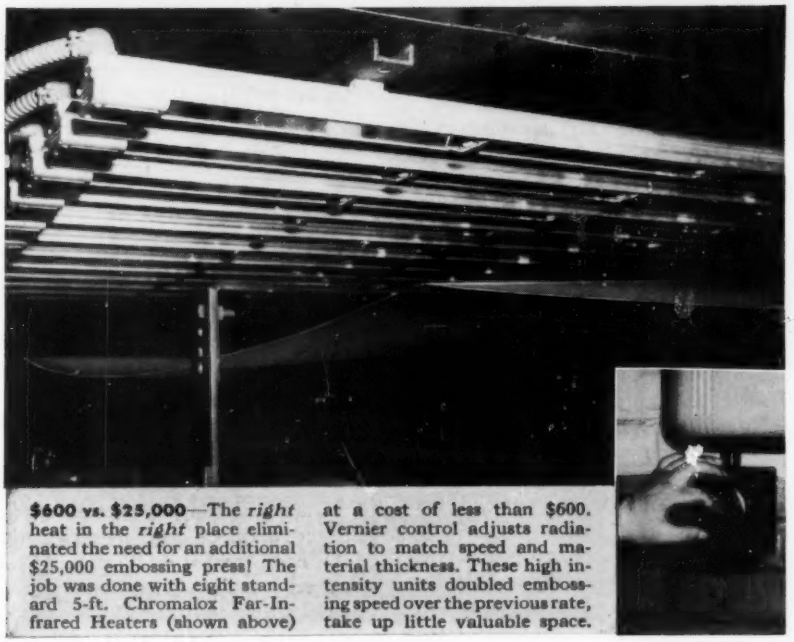
The new headquarters houses all the divisions of Union Carbide now located in the Cleveland area. These include **Bakelite Co., Carbide and Carbon Chemicals Co., Electro Metallurgical Co., Haynes Stellite Co., Linde Air Products Co.**, and **National Carbon Co.**

Hercules Powder Co., Inc., Wilmington, Del., announces the election of a new vice president and the appointment of two department general managers as follows: **John J. B. Fulenwider**, general manager of the company's Cellulose Products Dept. and a member of the board of directors since 1945, was elected a vice president and member of the executive committee. **Elmer F. Hinner**, a member of the board since 1952 and general manager of Hercules' Virginia Cellulose Dept. since 1950, succeeds Mr. Fulenwider as general manager of the Cellulose Products Dept. **Edward G. Crum**, formerly assistant general manager of Cellulose Products, is now general manager of Virginia Cellulose.

Package Machinery Co. has elected the following officers and directors for its newly acquired subsidiary, **Reed-Prentice Corp.**, Worcester, Mass., which it recently purchased in a $4 million transaction: **Roe S. Clark**, president of the parent company, has been elected chairman of the board. **Tom Miller**, **Harold Mosedale, Jr.**, and **Charles E. Palmer**, vice presidents and directors of Package Machinery, are new members of the

CHROMALOX Production Tips

PROFITABLE IDEAS FOR PLASTIC PROCESSING



$600 vs. $25,000—The *right* heat in the *right* place eliminated the need for an additional $25,000 embossing press! The job was done with eight standard 5-ft. Chromalox Far-Infrared Heaters (shown above) at a cost of less than $600. Vernier control adjusts radiation to match speed and material thickness. These high intensity units doubled embossing speed over the previous rate, take up little valuable space.

UNIFORM, HIGH INTENSITY HEAT AND PRECISE CONTROL RESULT IN HIGH SPEED VINYL FUSING AND EMBOSSING

Many manufacturers of vinyl films are fusing cast vinyl in as little as ten seconds at speeds up to 100 yards per minute! They are obtaining this high speed production without expensive equipment and high pressure steam. Instead they use all-metal Chromalox Electric Radiant Heaters which are economical in initial cost and easy to install, even in existing equipment. Too, they occupy very little floor space.

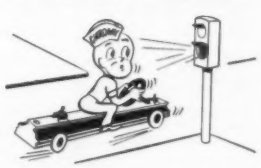
Basic reasons for the success of Chromalox Radiant Heaters in processing vinyls are the high heat intensity, uniformity and the precise control possible with these far-infrared generators.

In usual production procedure, plastisol film requires one minute at 400°F. to fuse in a convection type oven. When the film is processed in a Chromalox Radiant Oven fusing takes place in ten seconds. In the manufacture of organisol vinyl films Chromalox Radiant Heaters perform equally well.

When the vinyl films require embossing or laminating, Chromalox Radiant Heaters do a better job, more quickly in both unsupported and supported films. In film up to 20 mils thick, high-intensity Chromalox Radiant heaters are placed on only one side of the film.

Full details for fusing, embossing and laminating cast and calendered materials are contained in "The Vinyl Report" listed in the right column. Write for your copy.

BEING "COLOR BLIND" IS BIG HELP IN PROCESSING



White or black . . . transparent, translucent or opaque—it makes little difference when Chromalox radiant heat is on the job. That's because the radiation is in the invisible far-infrared wavelength that is absorbed with almost equal speed by all colors and surfaces. Even clear glass and plastics absorb far-infrared readily and heat up quickly.

CHROMALOX APPLICATION DATA TO HELP SOLVE YOUR PROBLEMS

☐ **DEHYDRATING VINYL SHEETS**—How production was increased and rejects reduced in laminating vinyl sheeting between two pieces of plate glass. *Report R-121.*

☐ **FUSING VINYL TO CHIP BOARD**—How Chromalox Electric Radiant Heaters improved quality, reduced heating time and increased production 500 per cent. *Report R-129.*

☐ **HEAT FOR EMBOSSING CHLORIDE PLASTIC WEB MATERIAL**—How twelve Chromalox RAD-6303 Radiant Heaters replaced an inefficient heat source and resulted in lower operating costs, better end-products, and increased production by 50 per cent. *Report 132.*

☐ **FUSING PLASTISOL COATING TO MAKE IMITATION LEATHER**—How preheating, fusing and embossing are performed in a continuous in-line operation using standard Chromalox Electric Radiant Heaters, input controllers and other components. Chromalox Heaters were installed with minimum expense and less time. *Report R-143.*

☐ **VINYL TREATING CLOTH**—Case history of Chromalox Radiant Heaters being used to fuse vinyl into cotton fabric for garden gloves. *Report L-1068.*

☐ **DOUBLING EMBOSSING CAPACITY**—How a $600 investment in Chromalox Electric Heaters saved an expenditure of about $25,000 for additional embossing equipment. *Report L-1086.*

☐ **VINYL REPORT**—An authoritative paper on the use of Chromalox Far-Infrared Radiant Heaters for fusing and embossing cast and calendered materials.

☐ **10 ADVANTAGES OF CHROMALOX FAR-INFRARED**—A quick digest of the pertinent facts which make "color blind" far-infrared the ideal heat source for plastics processors. *CS-604-B.*

☐ **101 WAYS TO APPLY ELECTRIC HEAT**—A 32-page handbook illustrating and describing approved methods of electrically heating processing equipment, liquids, air, etc.

☐ **ELECTRIC HEAT FOR BETTER PLASTICS PROCESSING**—Case studies of how Chromalox Electric Heaters of all types have been used for drying, forming, shaping, fusing, laminating, molding and other uses in the plastics field.

☐ **CHROMALOX CATALOG 50**—Complete application details, specifications and other data on over 15,000 types, sizes and ratings of Chromalox Electric Heaters.

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7503 Thomas Boulevard, Pittsburgh 8, Pa.

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Company _____

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THE PLASTISCOPE

board of directors. **Roger L. Putnam** has been made president, **Frederick W. McIntyre, Jr.**, vice president in charge of sales, and **Jackson R. Holden**, secretary.

Continuing in their respective positions are **Donald H. Dalbeck**, vice president and treasurer; **Iver G. Freeman**, vice president; and **Douglas L. Brennen, assistant treasurer.**

Eastman Machine Co., Buffalo, N. Y., manufacturer of cutting machines for plastic fabrics, coated fabrics, fibrous glass mats, etc., has moved its New York office to 315 W. 35th St., New York 1, N. Y. **Sol Redlich** has been named sales manager of the New York office.

Wallace & Tiernan, Inc., Belleville, N. J., announces that **Dr. F. Visser 't Hooft** has been elected vice president in charge of its Lucidol Div. and **Charles H. Rybolt**, formerly sales manager of the division, has been appointed general manager.

Soule Mill, New Bedford, Mass., has named **Edmond Kelly** of **Allied Products Engineering Corp.**, 1222 E. Grand Ave., El Segundo, Calif., as its West Coast distributor of glass fabrics.

Chester J. Abend, formerly chief of design and development of **Braun-Crystal Co.**, has formed his own industrial design office at 19-20 147th St., Whitestone, N. Y.

Minneapolis-Honeywell Regulator Co. has purchased all of the outstanding capital stock of **Doelcam Corp.**, Boston, Mass., manufacturer of precision instruments and control equipment for aircraft and industrial uses.

Mycalex Corp. of America, Clifton, N. J., has opened three new sales offices located at 5657 Wilshire Blvd., Los Angeles, Calif.; 6677 N. Northwest Highway, Chicago, Ill.; and 801 S. E. 8th St., Minneapolis 14, Minn. **Leslie F. Thompson** has been named manager of the Chicago office and **D. A. Schultz**, manager of the Minneapolis unit.

Continental Can Co., 100 E. 42nd St., New York 17, N. Y., has elected **Lawrence Wilkinson** as group vice president and **Charles B. Stauffacher** as vice president in charge of finance. Mr. Wilkinson, who has served as vice president in charge of finance since January 1952, will now direct the activities of the company's fibre drum, paper container, flexible packaging, and crown and cork divisions.

The company also announces the appointment of **American Supply Co.**, 753 Washington St., Gary, Ind., and **Robert W. Reiss Co.**, 1109 N. 108th St., Highway 100, Milwaukee, Wis., as distributors of Continental's Conolite, a decorative plastic laminate for home surfacing uses.

Karlton Machinery Corp., 210 E. Ohio St., Chicago 11, Ohio, is a new sales and engineering organization specializing in hydraulic hot-plate presses, tapeless veneer splicers, precision veneer clippers, rotary wood slicing machines, and special machinery.

Serving the wood, hardboard, plastics, and rubber industries, Karlton Machinery is the United States representative of **Becker & Van Huellen**, Krefeld, Germany, Europe's largest builder of hydraulic presses. The company also represents **Mueller Ltd.**, Brugg, Switzerland, for its cross-feed tapeless veneer splicer, as well as other Swiss and German machinery builders.

H. K. von Maltitz, head of the new company, was formerly associated with Plycor Co., Div. of Earle Hart Woodworking Machine Co. Mr. von Maltitz introduced the modern hot press process for making plywood into this country in the early 1930's.

Amplex Reinforced Plastics, Inc., 2325-31 Fairmount Ave., Philadelphia 30, Pa., subsidiary of **Amplex Mfg. Co.**, is the new name of the company formerly known as Baker Plastics Co., Inc.

National Distillers Products Corp., 120 Broadway, New York 5, N. Y., has integrated all its chemical activities into one division and made the following appointments: **Lee A. Keane**, formerly vice president of U. S. Industrial Chemicals Co., Div. of National Distillers, has been named director of chemical sales and will be in charge of the sales of all the corporation's chemical products; **Robert H. Cornwell** has been appointed director of production for all the chemical plants of National Distillers and its subsidiaries; and **Dr. Stuart Schott** is now director of research and will be responsible for research and pilot plant operations for the entire firm and its subsidiaries.

Acheson Dispersed Pigments Co., 2250 E. Ontario St., Philadelphia 34, Pa., has appointed **B. E. Dougherty Co.**, 1807 E. Olympic Blvd., Los Angeles 21, Calif., and 725 2nd St., San Francisco, Calif., as its West Coast distributor. Dougherty will handle Acheson's dispersions and vinyl printing inks, as well as base blacks, in the Pacific Coast states.

Nosco Plastics, Inc., Erie, Pa., announces the appointment of **Harold S. Cloyd**, formerly chief engineer, as vice president in charge of engineering and **Paul C. Roche**, former sales engineer, as sales manager.

Nytef Plastics, Inc., Kenilworth, N. J., is a new company specializing in the extrusion of rigid nylon (Zytel 101) rods, tubes, and shapes. The company's sales offices and warehouse are located at 630 Broadway, New York, N. Y.

Orders for immediate deliveries of rods from ½ to 2½ in. diameters are now being accepted by the firm. Other sizes will be available shortly.

Plaskolite, Inc. has moved its plant and offices to 222 Neilston St., Columbus, Ohio. The move affords the company more diversified operations in the field of plastic extrusion, Plaskolite manufactures plastic extrusions for the appliance and lighting fixture industries and for outdoor signs, as well as sheeting for vacuum forming.

Crompton-Richmond Co., Inc., 1071 Avenue of the Americas, New York 18, N. Y., announces the election of the following officers: **Frank W. C. Timson**, vice president, **Herbert F. Gramstorff**, controller, **Walter E. Gay**, assistant treasurer, and **Nathaniel P. McCaffrey** and **Fred J. Hebner**, assistant secretaries.

The Dow Chemical Co., Midland, Mich., announces that **William B. Guerrant** and **Roy C. Simon** have been named field representatives and will be in charge of technical assistance in the industrial uses of plastics

HOBBS

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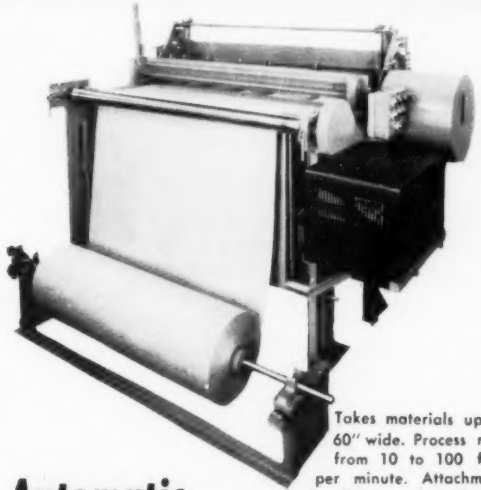

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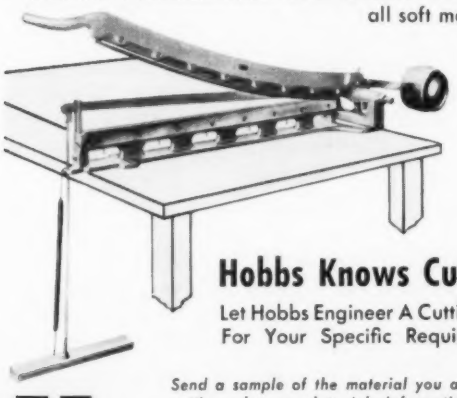

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coatings. Mr. Guerrant will handle coatings technical service in the Southeast from Dow's Atlanta, Ga., office and Mr. Simon, with similar duties, will work from Dow's Los Angeles, Calif., office.

Bassons Industries Corp., 1432 West Farms Rd., Bronx, N. Y., has announced a 5¢ dividend on common stocks purchased as of December 15, 1954. The company's sales for the six months ended September 30, 1954 were listed as $456,093.75 with a net operating profit of $23,237.32.

The Peltan & Leru Corp., 383 Fifth Ave., New York, N. Y., is a newly formed sales and design organization. Officers of the new firm are **Lee Pelzman**, president; **Edward M. Rubin** and **David Tanner**, vice presidents; **Morton Levine**, secretary; and **Edward Carlson**, treasurer.

Behr-Manning Corp., Troy, N. Y., announces that **Edwin C. Evans** has been named vice president and assistant general manager of the company and **William I. Clark, Jr.** has become assistant to the president and will also continue with his present responsibilities as secretary of the firm.

Food Machinery & Chemical Corp., Buffalo, N. Y., announces that **Buffalo Electro-Chemical Co., Inc.** and **Becco Sales Corp.** have been merged into the corporation and will operate as **Becco Chemical Div. of Food Machinery.** The change is solely for the purpose of simplifying the corporate structure. Becco's policies and personnel will be unaffected.

Pribble Plastics Products, Inc., New Haven, Ind., has called our attention to an error in listing a 28-ton Logan plunger press as part of its equipment. It should have been listed as a 280-ton machine.

Hooker Electrochemical Co., Niagara Falls, N. Y., announces that **Oscar C. Zaske, Dr. Frank P. Avonda,** and **Dr. Donald H. Campbell** have joined the company's research and development department. Mr. Zaske has been assigned to the plastics and resins group and Dr. Avonda and Dr. Campbell have both been assigned to the fluorine chemistry group. Mr. Zaske was formerly associated with Glenn L. Martin Co., Baltimore, Md., as a senior development engineer in plastics.

Landers Corp.'s new research director and laboratory manager are **Charles J. Chaban** and **William A. Corry**, respectively, according to an announcement by **Frank W. Baker**, vice president in charge of research and development. Mr. Chaban will concentrate on research projects. Mr. Chaban has had previous experience with I. G. Farbenindustrie A.G. in Germany, the Union des Teintureries, Ghent, Belgium, and S. A. Manta, Weismunster, Germany. He holds six United States patents and four foreign patents on the stabilization of polyvinyl chloride.

Before joining Landers, Mr. Corry was civilian chief of the textile branch of the Air Research and Development Command, Wright-Patterson Air Force Base, Dayton, Ohio. At the end of the Pacific War, he was a member of the first Air Force mission sent to Japan to gather available technical data on textile research. Other former affiliations of Mr. Corry were with the Army Quartermaster Corps, the Department of Agriculture, and The General Tire & Rubber Co. as head of quality control in General's Barnesville, Ga., plant.

Harte & Co., Inc., suppliers of vinyl fabrics and polyethylene film, have moved to new offices and showrooms located at 16 East 34 St., New York, N. Y.

PERSONAL

James R. Turnbull has been named vice president of **Monsanto-Kasei Kogyo, K. K.**, Tokyo, Japan. Mr. Turnbull, formerly assistant to the director of marketing of Monsanto Chemical Co.'s Plastics Div., replaces **Albert W. Dunning**, who will return to the United States for an assignment with the Plastics Div.

Monsanto-Kasei, an associated company of Monsanto and Nipponkasei Chemical Industries Ltd. of Tokyo, was formed in 1951 to manufacture plastics and chemicals. Mr. Turnbull will also be a member of the board and of the executive committee of the Japanese company.

Mr. Turnbull joined Monsanto's Plastics Div. in 1938 and served successively in sales promotion, product development, and general sales administrative positions. During World War II, he was appointed chief of the thermoplastics section of the War Production Board.

John A. Field has been appointed vice president of **Carbide and Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp.** He will be responsible for sales development and related activities, including the company's fellowships at Mellon Institute, Pittsburgh, Pa.

Mr. Field has just returned to the company after a six-month leave of absence to act as assistant administrator of the Business and Defense Services Administration, United States Dept. of Commerce.

L. R. Modlin, Jr., former staff representative, has been named field sales manager of **B. F. Goodrich Chemical Co.'s** general chemical sales department, Rose Bldg., Cleveland, Ohio. Mr. Modlin joined The B. F. Goodrich Co., Akron, Ohio, in 1942, where he was engaged in synthetic rubber research until 1945, when he moved to BFG Chemical Co.

Dr. Robert H. Krieble has been made manager of the **Chemical Development Dept.** of **General Electric Co.'s Chemical and Metallurgical Div.**, Pittsfield, Mass.

C. G. Stupp has been appointed vice president of **Barrett Div., Allied Chemical & Dye Corp.** He was first employed by Barrett 38 years ago as a research chemist in the Edgewater, N. J., plant.

Edward More has been named advertising manager of **The Formica Co.**, 4614 Spring Grove Ave., Cincinati 32, Ohio. He was formerly national assistant director of advertising of Westinghouse Electric Corp.

Lawrence W. Heinze, formerly of L. W. Heinze Plastic Co., St. Paul, Minn., has been appointed manager of process and development of **Fiberglass Products Co.**, Pocatello, Idaho.

L. N. Thomas has been named manufacturer's agent for **Seiberling Rubber Co.'s Plastics Div.**, New-

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comerstown, Ohio. He will represent the company in the sale of Seilon, Seiberling's rigid polyvinyl chloride, in the New England area. Mr. Thomas was formerly with the industrial plastics firm of Hartwell & Son, Inc., Boston, Mass., and now handles a line of corrosion-resistant materials in New England.

William M. Gallahue has been named general sales manager of **Mount Hope Machinery Co.**, Taunton, Mass. The company is the originator of the Free-Wheeling Expander now in general use in the textile, paper, and plastic web handling industries.

John Fertig has been appointed to head quality control of all manufacturing of **Resin Industries**, Santa Barbara, Calif. Mr. Fertig's background and knowledge of Government specifications equips him for the job of supervising control of the quality of the vinyl tubing, sleeving, garden hose, and other products manufactured by the company.

George A. Brightman, 3rd, formerly of Bakelite Co., is now president of **Scarmar Mfg. Co.**, 102-106 Straight St., Paterson, N. J.

Alexander C. H. Weiss has been named regional sales manager of **Russell Reinforced Plastics Corp.**, with headquarters at the firm's Boca Raton, Fla., plant.

Irving N. Levine is now vice president in charge of sales and promotion of Lomaware plastics housewares for **Loma Plastics, Inc.**, 3000 W. Pafford St., Ft. Worth, Texas.

Clark Wormer has been appointed sales representative of the **Plastics Div., Fabricon Products, Inc.**, River Rouge, Mich. He was formerly associated with Pittsburgh Plate Glass Co.'s Fiberglass Div.

Carl W. Patton has been appointed to the newly created post of general manager of advertising and public relations of **Bakelite Co., a Div. of Union Carbide and Carbon Corp.** Mr. Patton joined the corporation in 1932 as a plastics research chemist with Carbide and Carbon Chemicals Co. in So. Charleston, W. Va. In 1937, he was appointed to a 2-yr. Union Carbide fellowship at Mellon Institute, Pittsburgh, Pa. Mr. Patton became associated with the firm's plastics sales department in 1939 and for the past nine years has been manager of Bakelite Co.'s Surface Coating Materials Sales.

Mr. Patton's successor as manager of Surface Coating Materials Sales is **Roger Calcibet**, his former assistant in that department.

David Shopkorn has joined the sales staff of **Harte & Co., Inc.**, 16 E. 34th St., New York 16, N. Y. He was formerly associated with Whitman Plastics Corp., Lynn, Mass., as sales manager.

L. I. Hadden has been appointed to the newly-created position of general manager of **Regal Plastic Co.**, 2800 E. 14th St., Kansas City 27, Mo. For the past five years, Mr. Hadden has been president and general manager of Standard Mfg. Corp., Chicago, Ill.

E. W. Bousquet, formerly supervisor of polyvinyl emulsion operations of **National Starch Products, Inc.** at Plainfield, N. J., has been appointed plant superintendent of the company's new Meredosia, Ill., plant.

F. W. McIntyre, Sr. has retired from **Reed-Prentice Corp.**, Worcester, Mass., after 35 years with the company. Mr. McIntyre was elected president of the company in 1944 and became chairman of the board in April 1954. He is now acting as a consultant to the company but is not active as an officer.

Martin Batiuk has been named technical section manager of the reinforced plastic products department of **The B. F. Goodrich Co.'s Industrial Products Div.**, Akron, Ohio. He joined the company in 1939 in the design section of the machine development department.

Edward H. Winkleman has been appointed New York sales representative of **Pittsburgh Coke & Chemical Co.'s Plasticizer Div.**, Pittsburgh, Pa. He replaces **G. J. Esselen, III**, who has been named sales manager of the company's **Activated Carbon Div.** Mr. Winkleman will headquarter at the firm's office in the Empire State Bldg. He was formerly assistant sales manager of U. S. Testing Co.

Michael D. Vaccaro has been elected vice president in charge of Eastern sales of **Witco Chemical Co.**, 260 Madison Ave., New York, N. Y.

William W. Krause has been named technical representative to cover the New England area for **Claremont Pigment Dispersion Corp.**, 110 Wallabout St., Brooklyn 11, N. Y. He was formerly connected with Smith Chemical & Color Co.

Dr. R. H. Crist has been named manager of **Carbide and Carbon Chemical Co.'s Physical Processes Depts.** He will be in charge of coal hydrogenation projects in Charleston and Institute, W. Va.

Dr. Crist has been actively connected with coal hydrogenation and other research and development projects of the department since 1945. He joined the group following five years in atomic energy research on the Manhattan project.

John A. Morgan has been elected vice president of **Glass Fibers, Inc.**, Toledo, Ohio, and appointed general manager of the company's Western Div. He succeeds M. Dean Worcester who has resigned.

Donald S. Black has been appointed to the sales service section of **Goodyear Tire & Rubber Co.'s Chemical Div.** Mr. Black will handle technical sales service on rubber reinforcing resins and the Chemigum rubbers. Since 1951, he has worked for Goodyear in compound and process development work for the Industrial Products Div.

A. K. MacInnes has been appointed to the technical sales staff of **Industrial Products Div., Canadian Resins & Chemicals, Ltd.**, Toronto, Ont.

Abraham Krasnoff has been named vice president of **Micro Metallic Corp.**, a Pall Filtration company, Glen Cove, N. Y. Pall Filtration Companies are developers and producers of porous stainless steel, alloy, and fluorocarbon plastic filter media and equipment for industry and the military.

Michael S. Goldberg has been appointed general sales manager of **I. B. Kleinert Rubber Co.**, 485 Fifth

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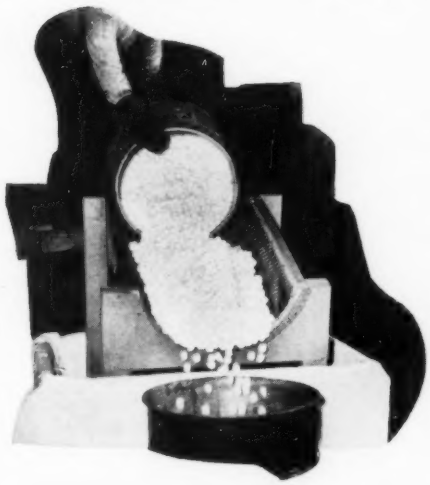
By truck from producing points to Buffalo, to Chicago and back to Buffalo again went drums of three manufacturers' Maleic Anhydride. Then the contents of each drum were carefully screened and the 2 mesh "fines" weighed. Here's what the scales showed:

NATIONAL "TABLETS"—1.12 lb. BRAND A—7.78 lb. BRAND B—10.40 lb.



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We knew our new Moundsville plant was making exceptionally good-to-look at, easy-to-handle Maleic Anhydride. We knew our new tablet form resists degradation in shipping and handling. But, frankly until now we didn't fully realize how downright all-around good National Maleic Anhydride Tablets really are. There's no price premium on this premium quality product. So why not have the advantages of uniform, quick-dissolving, safer-to-handle National Maleic Anhydride Tablets by sending your next order to our nearest office?

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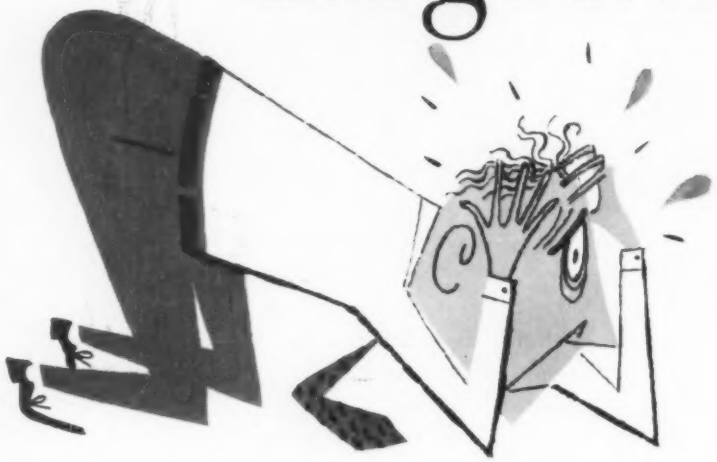

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THE PLASTISCOPE

Ave., New York 17, N. Y., according to an announcement by **Ralph K. Guinzburg**, president of the company. Mr. Goldberg succeeds the late Harold W. Quinby, who had been general sales manager for many years.

Frank Y. Speight has joined the staff of the **American Society for Testing Materials**, 1916 Race St., Philadelphia 3, Pa., as assistant technical secretary.

John F. Murphy has been promoted to technical service manager of Ultron calendered products of **Monsanto Chemical Co.'s Plastics Div.**, Springfield, Mass. Mr. Murphy, a member of the sales department since 1953, joined the division in 1946.

Lynn G. Goodnough, Jr. is now sales manager of the Kalistron Upholstery Dept. of **United States Plywood Corp.'s Flexible Materials Div.**, 55 W. 44th St., New York 36, N. Y. Mr. Goodnough was formerly associated with the Furniture Div. of Goodall Fabrics, Inc.

William W. Gordon has been appointed general sales manager for all Panelyte products of **St. Regis Paper Co.'s Panelyte Div.**, 230 Park Ave., New York 17, N. Y. He was formerly sales manager of United States Playing Card Co. for 14 years.

Bert W. Maidment, formerly toy sales manager has been promoted to the position of vice president of **Thomas Mfg. Corp.**, 80 Clinton St., Newark 5, N. J. Mr. Maidment, with 20 years experience in all phases of plastics products manufacture and marketing, will devote his time to the sales activities of all the company's divisions, including the promotion and merchandising of toys, premiums, household items, novelties, and notions.

Admiral J. J. ("Jocko") Clark, U.S.N. (retired), has been appointed a vice president of **Radio Receptor Co., Inc.**, 240 Wythe Ave., Brooklyn 11, N. Y.

Deceased

Ruskin K. Kewley, vice president of **Plasticrafters, Inc.**, Cicero, Ill., and of **Colonial Molded Products**,

North Chicago, Ill., died suddenly. Prior to his affiliations with these firms, Mr. Kewley was associated with P. R. Mallory Plastics, Inc. and Industrial Products Co., both in Chicago.

Deane C. Severance, past chairman of the West Coast Section of S.P.I., died at the age of 55 of a heart attack. Mr. Severance was the founder of **Lee Deane Products, Inc.,** a plastics molding company.

Lawrence Ottinger, founder and chairman of the board of **United States Plywood Corp.,** 55 W. 44th St., New York 36, N. Y., died of a heart attack during his sleep in his seventy-first year.

Harry C. Hackett, staff manager of sales and assistant secretary of **National Vulcanized Fibre Co.,** Wilmington, Del., died at his home after a lingering illness.

MEETINGS

Feb. 8-10—The Society of the Plastics Industry, Inc., Tenth Annual S.P.I. Reinforced Plastics Division Conference, Hotel Statler, Los Angeles, Calif.

Feb. 22-23—The Society of the Plastics Industry (Canada), Inc., Thirteenth Annual S.P.I. Canadian Conference, Hotel London, London, Ont.

April 4-7—American Chemical Society, Div. of Paint, Plastics, and Printing Ink Chemistry, Cincinnati, Ohio.

April 6-10—World Plastics and Trade Exposition, National Guard Armory in Exposition Park, Los Angeles, Calif.

April 13-15—The Society of the Plastics Industry, Inc., S.P.I. Pacific Coast Section Conference, Palm Springs, Calif.

April 16-17—Packaging Machinery Manufacturers Institute, Semi-annual Meeting, Palmer House, Chicago, Ill.

May 7-15—The Society of the Plastics Industry, Inc., 1955 Annual Conference, Convention Cruise aboard *Queen of Bermuda* to Havana, Cuba, and Nassau, B.W.I.

May 18-19—The Chemical Market Research Association, Annual Meeting, Hotel Plaza, New York, N. Y.

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MACHINERY and EQUIPMENT FOR SALE

HYDRAULIC PRESSES: 1—Erie Belt Press, 4242 Tons, 2—3" openings, 18'-0"x52" steel steam platens, 6 rams—30" diam. x16" stroke: 1—Birdsboro, 2000 Tons, down-acting ram 34" diam, x14" stroke, 48" DLO, 42"x42" bed area; 1—Farrell, 1000 Tons, 2—6" openings, 42"x42" Steel Steam platens, ram 36" diam. x12" stroke; 1—HPM, 750 Tons, down-acting, ram 28" diam. x43" stroke, 72" DLO, 59"x44" bed area, MD Low and High Pressure Pumps and Accumulator System; 1—Erie, 700 Tons, 2—7" openings, 38"x38" steel steam platens, ram 30" diam. x17" stroke. 1—Baldwin-Southward, 400 Tons, slab-side, 30"x30" steel steam platens, 23" DLO, ram 21"x17" stroke; 1—Farrell, 393 Tons, 48"x48" steam platens, 2—15" openings, 4 rams 10" diam. x24" stroke, approx. 15" per opening; 1—Farrell, 200 Tons, 2—6" openings, 36"x36" steel steam platens, ram 16" diam. x11" stroke; 1—Watson-Stillman, 100 Tons, down-acting ram 11½"x9½" x6" stroke, 22"x20" bed, 24" DLO, self-contained, 15 HP MD Vickers Pump. Unit practically new; 1—Watson-Stillman, 100 Tons, 11¾"x12" platens, 22½" DLO, ram—8" diam. x15" stroke, complete with 3 HP MD pump; 1—HPM, 100 Tons, 18"x18" platen area, ram—8" diam. x18" stroke, 30" DLO, steel cylinder—4000 PSI; 1—HPM, 35 Tons, down-acting ram 6" diam. x6" stroke, 15" DLO, 12"x6" bed area, self-contained; 2—Watson-Stillman Laboratory, 30 Tons, 6½"x 9½" electrically heated platens, integral hand pumps. INJECTION MOLDING MACHINES: 1—Plasticor Vertical 2 oz; 1—HPM Horizontal Model 54, 2 oz; 2—Reed-Prentice, 2 oz; 1—Watson-Stillman, 2 oz., Frame suitable up to 6 oz; 2—Lester, 4 oz. 2—HPM Model 200-H, 8 oz; 1—Lester, 12 oz; 2—Impco Model VF-822A, 22 oz. EXTRUSION MACHINES: 1—MPM, 1951, 3HP Sterling Speed-Trol Drive; 2—MPM, 1951, 40 HP M.D.; 1—MPM Pelletizer, 95% New, Capacity up to 1000 lbs. per hour; 1—Royle No. 1, Rubber, 5 HP M.D.; MIXERS: Baker-Perkins, Lab Size 6, Class BB, Stainless Steel Sigma Blades Jacketed Body, arranged for Motor Drive Banbury No. 1, Completely Chrome Plated Interior for Plastics, 50 HP Motor Drive, Oil Heating System. All Controls; 1—Ball & Jewell Midget, Stainless Steel, 1 HP M.D. Rotary Cutter. Other sizes and makes of Plastics and Rubber Extruders; also Mills, Calenders, Mixers, Grinders, Pumps, Valves, Platens, etc. JOHNSON MACHINERY COMPANY, 683 P Frelinghuysen Avenue, Newark 5, New Jersey. Tel: Bigelow 8-2500. What have you for sale? What are you looking for?

KUX 2½" dia. Single Punch Preform Machine. Leominster 8 oz. Injection Molding Machine complete late type. Plastic and Rubber Equipment. Farrell 16"x48", 15"x36" and 6"x12", 2 roll mills. Mills and Calenders up to 84". New Seco 6"x12" and 6"x16" Lab. Mixing Mills and Calenders. Rubber & Plastic Extruders. 200 ton Hobbing Press 18"x14" platens. HPM 200 ton 30"x48" Platens. New Loomis 340 ton, 24"x56" platens. 200 ton Brunswick 21"x21" Platens, 14" Ram. Southwark 30 ton 14"x14" platens, semi-auto, 150 Ton Bolling 20"x20" platens. Also Lab. to 2000 tons from 12"x12" to 48"x48" Hydr. Oil Pumps. Gould 75 HP motor Dr. 2 stage Centrif. Pump 250#. W. S. 4 Plgr. High and Low Pressure Hydr. Pump. Elmes Hor. 4 Plgr. 4500 lbs. and 5500 lbs., Hydr. Accumulators. Stokes Automatic. Molding Presses. Rotary & single Punch Preform Tablet Machine ½" to 4". Injection Molding Machines 1 oz. to 32 oz. Baker Perkins Jacketed Mixers. Plastic Grinders. Heavy duty mixers, gas boilers. Partial listing. We buy your surplus machinery. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn 15, N.Y. STerling 8-1944.

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(5) NEW WATSON-STILLMAN EJECTION Molding Heating Chambers, one four ounce, one six ounce, two eight ounce, one sixteen ounce. Price one third the cost of new. New 75 ton presses, size 22x22, 10" ram, 10" stroke, $1100 each, ten day delivery f.o.b. Brooklyn, New York, one or more can be obtained. HYDRAULIC SAL-PRESS CO., INC., 388 Warren Street, Bklyn., N. Y.

FOR SALE: 1—F.B. 32"x92" inverted-L 4 Roll Calender, reduction drive, d.c. vari-speed motor; 1—Royle #4 Extruder, motor driven. 1—6"x12" Laboratory Mill, m.d. 1—Ball & Jewell #2 Rotary Cutter, 15 h.p. motor. 3—#28 Devine Vac. Shelf Dryers, 19—59"x78" shelves, complete. 1—Farrell-Birmingham 6"x13" 3 Roll Calender. 3—Colton #5½ single punch Cabot machines, m.d. 1—Read-Standard 2000 lb. steel horizontal mixer. 1—Farrel 20"x22"x60" mill, top cap frame, falk reduction drive, 100 h.p. motor. 2—Farrel 16"x42" Mills with reduction drive and 100 h.p. motor. 4—Hymac 125 ton Molding Presses, 16"x16" electrically heated platens. Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

AVAILABLE AT BARGAIN PRICES
Colton 2RP and 3RP Rotary & #5½ Tablet Machines. Rotex, Tyler Hum-mer, Selectro, Robinson, Raymond, Grayco, Great Western Sifters. Mitts & Merrill 15CD Rotary Cutter. Mikro Bantam, 1SH, 2TH, 3W, 4TH Pulverizers. Baker Perkins Heavy Duty Steam Jacketed, Double Arm, from 5 to 200 gal., Mixers (Unidor and Vacuum also). J. H. Day, from ¾ up to 100 gal., Imperial and Cincinnatus D. A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Gemco 2000 lb. Double Cone Blender. Package Machy. FA, FA2, FA4, U4, Miller, Hayssen, Wrap-King, Scandia, Oliver Auto. Wrappers—all sizes. REBUILT AND GUARANTEED—This is only partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements. UNION STANDARD EQUIPMENT CO., 318-322 Lafayette St., New York 12, N.Y.

SAVE WITH GUARANTEED REBUILT EQUIPMENT: 2 New R. D. Wood 500 ton embossing presses; 54"x26" platen, HYDRAULIC PRESSES; 40"x40", 36" ram, 1500 tons; 2—27"x27", 18" rams, 585 tons; 20"x20" 10" ram, 200 tons; 20"x20", 14" ram, 200 tons; 15"x15" 8" ram, 75 tons; 14"x14" 8" ram, 75 tons; 2—19"x24" 10" rams 78 tons; 18"x18", 7" ram, 50 tons; 10—26"x26" 7" rams, 50 tons; 12"x12" 7½" ram, 50 tons; 14"x14" 8" ram, 50 tons; 8"x9½" 4½" rams 20 tons; 16"x16" 3½" rams, 12 tons; Carver model 150 and 6"x 6" LABORATORY PRESSES; Stokes Model T, late type with drive; Stokes Model T, late type with hydraulic equalizer system and drive; Colton 5½T with drive PREFORM PRESSES; NEW UNIVERSAL DUAL PUMPING UNITS 3—15 HP; NEW LABORATORY MILLS and CALENDERS; HPM 6" ram, 2500# pressure ACCUMULATOR; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. UNIVERSAL HYDRAULIC MACHINERY COMPANY, INC., 285 Hudson Street, New York 13, N.Y.

FOR SALE: Stainless Steel Rotary Dryer, Link Belt Co., 5'2"x16', No. 502-16, with all auxiliary equipment. Roto Louvre type. Reply Box 24355, Modern Plastics.

FOR SALE: Hobbing Press 800 Ton W.S. (2) 300 Ton W.S. Presses 20x20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen Ball & Jewell Plastic Grinders. Standard Mystic Embossing Presses, Accumulators, Pumps, Valves. Many other Presses—Send For Bulletin. AARON MACHINERY CO., INC., 45 Crosby St., New York 12, N. Y. Tel. WAlker 5-8300.

1—STOKES 200 Ton, Hydraulic, Single Punch Press 10"x6" preform x5" depth of fill. 1—National 10"x20" two roll Mill with 25 HP motor; 1—Baker Perkins 100 gal. S.S. double arm jacketed Vacuum Mixer; 2—Baker Perkins, Readco 100 gal. Jacketed double arm Mixers; 1—Baker Perkins 50 gal. double arm jacketed Mixer 50 HP motor; 4—Stokes Rotary Preform Presses DD2, DDS2, D4 and D3; 1—Kux Model 15-25 double action Rotary Press; Also: Sifters, Cutters, Banbury Mixers, etc., partial listing; write for details; we purchase your surplus equipment. BRILL EQUIPMENT CO., 2407 Third Ave., New York 51, N.Y.

FOR SALE
Lester Injection Molding Machines. One 3S-27-12 ounce and one L3-15-20 ounce. Excellent condition; can be seen in operation. Need room, must sell.
STERLING PLASTICS CO.
1140 Commerce Avenue, Union, New Jersey

FOR SALE: 2-400 ton compression molding presses; 2 Stokes Model 294 Preform Presses, 4" tablet; 1-NRM 2½" plastic extruder; 2-Ball & Jewell #1½ cutters; 1-Colton 5½T Preform Press 3" diameter; also Mixers, Mills, Presses, etc. CHEMICAL & PROCESS MACHINERY CORP. 148 Grand Street, New York 13, N. Y.

FOR SALE: Injection Presses: 4, 8, 12, 32, oz. Reed, 8, 12 oz. Lester, 9, 16, 40 oz. HPM, 1 oz. Van Dorn, 6 oz. Lewis.—Extruder conveyors, Scrap grinders, small & large. Ovens. Compression & Transfer Presses: 50, 100, 250, 600 tons.—Preform press Stokes 280C. 42" Slitt. & Rewind machine. Big Fiberglass press & oven. Read Co. 6 qt. Mixer. Equipment to be inspected in operation. List surplus equipment with me. JUSTIN ZENNER, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: 12 oz. Watson-Stillman Injection Molding Press; 12 oz. Lester Phoenix Injection Molding Press; 50 Ton and two (2) 15 Ton Stokes Presses; 5 HP and 3 HP Pumping Units; 50 HP 670 RPM & 40 HP 1160 RPM Motors. JOHN F. CARSON, A & Venango Sts., Phila., 34, Pa., GArfield 6-2221

FOR SALE: 32 oz. Lester, 32 oz. H.P.M., 60 oz. H.P.M., 48oz. Lester, $45,000. 48 oz. DeMattia, new 20 oz. Lester, new 1950, $16,000. 16 oz. H.P.M., 1952 16 oz. Reed-Prentice, 1953. 12 oz. Lester, 1946, $7,000. 12 oz. Crown Moldmaster, $10,500. 12 oz. Watson-Stillman, excellent. 9 oz. H.P.M., $5,500. 8 oz. Fellows, 1948, $7,500. 8 oz. Reed-Prentice, double link, $6,000. 8 oz. Lester, 1949, $7,500. 8 oz. Leominster, $5,000. 6 oz. Reed-Prentice, $3,500. 6 oz. Lester, $4,000. 4 oz. Reed-Prentice. 1949, $4,750. 4 oz. Lester, 1949, $5,500. 4 oz. Impco, $8,000. 4 oz. Lester, $3,000. 4 oz. Lester vertical, $4,500. 3 oz. Fellows, $6,500. 2 oz. Watson-Stillman vert. almost new. Ball & Jewell Cumberland scrap grinders. 6 Tray Preheating ovens, $150. each. #235-A Stokes press. 80 ton Transfer & Compression press, brand new, $4,250. 3" cap. Extruder. New Italian make extruders. ACME MACHINERY & MANUFACTURING CO., 102 Grove Street, Worcester, Mass.

FOR SALE: One 8 oz. Reed Prentice in excellent condition, timers, pyrometers and IMS cylinder all new 1954, serial #20235. Machine located in Southeast. Reply Box 22055, Modern Plastics.

FOR SALE: Injection Molding Machines in perfect operating condition. 1—2 oz. Reed Prentice; 1—4 oz. Reed Prentice; 1—6 oz. Reed Prentice. CURTISS-WRIGHT, PLASTICS DIVISION—Carlstadt, New Jersey—Geneva 8-4000. Mr. S. R. Miccio.

FOR SALE: New Imported Extruders. Latest developments, self contained. Moderately priced. For details write or call ACME MACHINERY & MANUFACTURING CO., 102 Grove Street, Worcester, Massachusetts. Phone: Pleasant 7-7747.

FOR SALE: 12 ounce Watson-Stillman injection presses. Good condition, well maintained. Reasonably priced. Anxious to sell. 6 to 7 years old. Reply Box 24655, Modern Plastics.

MACHINERY and EQUIPMENT WANTED

MIDWEST MOLDER interested in purchasing for cash three injection molding machines. Can be Reeds or Lesters. Prefer 20 ounce, 24 ounce or up to 32 ounce capacity. Must be in top condition and late models. Reply in detail giving make, model, age, condition, location, delivery and lowest cash price. Address Box 22455, Modern Plastics.

(Continued on page 262)

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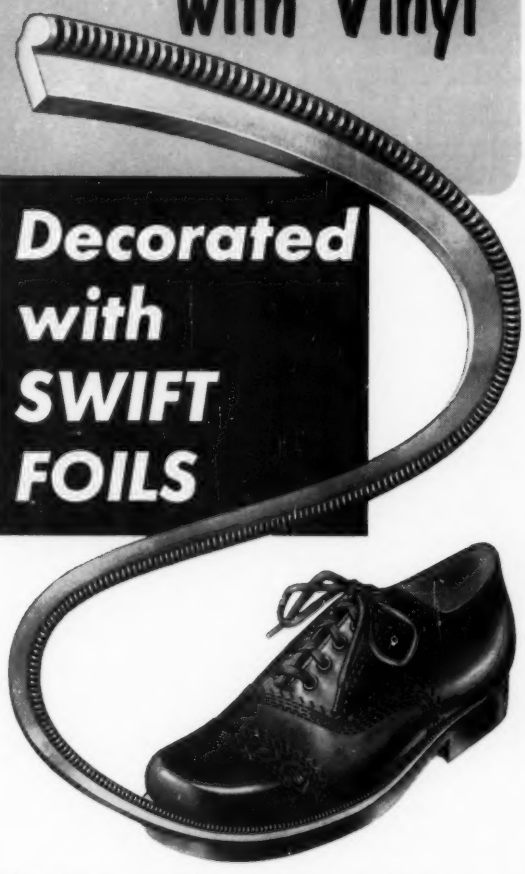

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CLASSIFIED ADVERTISING

(*Continued from page 260*)

WANTED: 8 oz. Injection Molding Machine, No. 3 Banbury Mixer, Calender, Extruder. Give particulars. Reply Box 24455, Modern Plastics.

WANTED—200 and 300 Ton late model self contained compression molding presses in good operating condition. Watson-Stillman—H.P.M. or French Oil preferred. Also 5½T Colton Preformer and 3KW, or 5KW Girdler Electronic Preheaters. Reply Box 23255, Modern Plastics.

WANTED: Machinery including Rubber Mills, Hydraulic presses, Study mixers, Calenders, Banbury mixers, Pulverizers, Grinders, Rotary cutters, Extruders, Screens, Injection Molding machines, Dryers. Will purchase complete plant. CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

WANTED—12 ounce injection molding machine in good operating condition. Impco preferred. Also Heavy Duty Grinder. SCIENTIFIC PLASTICS, INC., 373 Fourth Ave., New York, N. Y.

MACHINERY WANTED
One #11 Banbury; One #3A Banbury; one 84" Mill; two 60" Mills; one 12" Strainer; one 6" x 12" Laboratory Mill; one 2000 pound Jacketed Ribbon Blender; one Granulator 3000 pounds per hour.
WE ARE NOT DEALERS.
Reply Box 24555, Modern Plastics

WANTED—Used Presses, 30" x 54" minimum Platen, 500 ton minimum pressure—prefer French Oil, advise price, make, condition, etc. Reply Box 20255, Modern Plastics.

WANTED TO PURCHASE 8 oz. Reed. Must be late model in top condition. Advise price & location. PLAST-O-MATIC CORP., 37 Spruce Street, Leominster, Mass.

MATERIALS FOR SALE

FOR SALE: 4,000 lbs. Virgin Pastel Pink Polystyrene; 4,000 lbs. Virgin Delft Blue Polystyrene; 20,000 lbs. Virgin Pearl-effect Polystyrene, various colors; 4,000 lbs. Bright Royal Blue Polyethylene; 15,000 lbs. Black Polyethylene Pellets; 16,000 lbs. Reprocessed Flesh Butyrate. Large variety Bright Colors Acetate and Butyrate Pellets. All at low prices. Samples on request. A. BAMBERGER CORPORATION, 703 Bedford Avenue, Brooklyn, N.Y., Telephone MAin 5-7450.

FOR SALE: 20,000 lbs. each Red and Blue Styrene Pellets. Surplus lot Red Acetate Pellets—15,000 lbs. Both attractively priced. We are also in the market for all surplus plastic scrap and powder. FRANKLIN JEFFREY CORPORATION, 2004 MacDonald Avenue, Bklyn., N. Y. Tel.: ES 5-7943.

30,000 LBS. BLACK REPROCESSED POLYETHYLENE available for immediate delivery. Excellent offer. Reply Box 23755, Modern Plastics.

FOR SALE: Gauge .375 clear transparent sheets size 36 x 60" first grade. Available: 100 sheets Lucite HC 211; 100 sheets Plexiglas I @ $1.90 p. sq. ft.—Minimum order 1 Carton (8 sheets). Reply Box 24855, Modern Plastics.

WE OFFER way below schedule—60% discount —160,000 lbs. slightly off-spec Urea Molding Compound. ACETO CHEMICAL CO., INC., Flushing 54, New York. Phone: INdependence 1-4100.

MATERIALS WANTED

WANTED: Plastics Scrap and Rejects of all kinds, ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid. A. BAMBERGER CORPORATION, 703 Bedford Avenue, Brooklyn 6, N.Y. Telephone MAin 5-7450.

SELL US YOUR PLASTIC SCRAP. Polyethylene, Polystyrene, Acetate, Ethyl Cellulose, Acrylics, Butyrate, Nylon. GEORGE WOLOCH, Inc., 82 Beaver St., New York 5, N. Y.

SCRAP PLASTICS, all forms, waste and surplus plastic molding materials, rejects in any form. We will also buy your obsolete inventories of molding powders, stabilizers, plasticizers and other plastic and chemical materials. ACETO CHEMICAL CO., INC., 40-40A Lawrence St., Flushing 54, N.Y. INdependence 1-4100.

INTERESTED IN PURCHASING odd lots of resin and off resin. Any quantity, large quantities preferred. Reply in detail sending samples and identify material offered. Reply Box 20955, Modern Plastics.

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. DUKE PLASTICS CORP., 406 Atlantic Ave., Bklyn. 17, N.Y. ULster 8-9413.

MOLDS WANTED

DESIRE TO PURCHASE COMPRESSION MOLD for "Plastic Agitator" used in discontinued model of washing machine. Interested in purchasing 25 ton laboratory type transfer press. Reply Box 22355, Modern Plastics.

WE ARE PURCHASERS of injection moulds in good condition for European market. Offers with samples, size of moulds, number of prints, prices. . . . for the following items: toys, novelties, advertising goods, kitchen and household utensils, brushes, stationery, school furniture. Wanted also exploitation of patents, licenses, close cooperation with foreign firms. FRANCE MACHINES, Département Plastiques, 13 Bd. des Brotteaux, Lyon. (France)

TOY AND NOVELTY MOLDS WANTED. Nationally known Toy Manufacturer will buy active or inactive toy molds. Here is your opportunity to convert idle steel into ready cash. Give full details in your letter. All replies confidential. Reply Box 20855, Modern Plastics.

PLANTS WANTED

EXTRUSION AND VACUUM FORMING PLANT WANTED: A large plastic molder will furnish capital and sales organization for expanding Styrene extrusions and vacuum forming. Prefers location in Midwest area. Desires plant sufficiently staffed for rapid expansion. Reply Box 21855, Modern Plastics.

WANTED TO BUY: Small or medium sized plastic plant producing proprietary items. Willing to keep present personnel. WILSON PLASTICS, INC., Sandusky, Ohio. Phone: 4894.

WANTED POLYETHYLENE FILM MANUFACTURING PLANT: Will buy interest in plant for production and sales of Polyethylene seamless tubing and film. Desires Eastern location. Personnel must be aggressive and have thorough experience in manufacturing techniques and be ready for fast growth with added capital. Reply Box 21955, Modern Plastics.

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PLANT—SOUTHERN OHIO—Modern corner brick daylight building with display room. On main highway Cleveland to Portsmouth. Route 75. Two railroads, B&O, NY to St. Louis; C&O. Clear span 50'0x120'0". Hot air blower system. Two truck doors, fenestra windows, 8" concrete floor. Large water supply. Cheap power. Clean interior. Price $40,000.00. Will consider lease. BROWN COATING & EQUIPMENT COMPANY, 200 Penna. Ave., Wellston, Ohio.

HELP WANTED

WANTED: CHEMIST OR CHEMICAL ENGINEER—Pressure sensitive tape consultant for full time research. Give biography and will arrange interview. Reply Box 22255, Modern Plastics.

CHEMIST: An unusual opportunity is available for an ambitious young man in the research and development department of a well established manufacturer of flexible packaging materials with nationwide distribution. A sound fundamental knowledge of basic science and a graduate degree are prerequisites. Previous experience in food, plastic, paper, or packaging industries would be most helpful. Write about your personal history, educational background, past experience and salary expectation to Box 25055, Modern Plastics.

POLYETHYLENE FILM ENGINEER: Experienced in the manufacture of extruded seamless tubing and film. Large plastic fabricator wants to expand into that field. Wonderful opportunity for right man with a thorough background experience capable of setting up small modern production plant designed for rapid growth. Send full resume of qualifications and experience. Reply Box 21655, Modern Plastics.

IMPORTANT SPANISH PLASTICS INDUSTRY requires services of experienced American engineer or technician thoroughly familiar with the most modern processes used in molding reinforced plastic parts, in order to organize a division for this specialty. Address inquiries, giving full references and experience to: SOLEROCA, Fusina 1, 3°, Barcelona, Spain.

RESIN CHEMIST OR CHEMICAL ENGINEER with two to ten years research or development experience to do research and development on phenolic resin problems for midwestern grinding wheel manufacturer. Previous experience in abrasives not necessary. A key position in a growing organization. Reply Box 21555, Modern Plastics.

POSITION OPEN in substantial well-known company for experienced national sales manager for complete plastic wall tile line. Big opportunity for right man. Reply Box 22755, Modern Plastics.

VINYL FILM & SHEETING PRODUCTION FOREMAN OR SUPERVISOR. Experienced in quality control and standards. Reply Box 24155, Modern Plastics.

REINFORCED PLASTICS SUPERINTENDENT. We are looking for a working foreman to take charge of our Fiberglas reinforced polyester department. Must have thorough knowledge of matched metal dies. Knowledge of vacuum bag work desirable. Will be expected to handle production and experimental work for aggressive, growing company in the Middlewest. Excellent salary and advancement possibilities. Reply Box 22955, Modern Plastics.

EXTRUSION AND VACUUM FORMING ENGINEER: To set up and operate custom production facilities in Styrene sheet. To locate in Midwest near potential volume production center. Reply Box 21755, Modern Plastics.

A YOUNG AGGRESSIVE COMPANY with proven record located in the Middle South Atlantic States wishes to establiah a Plastics Moulding Division. We need an aggressive, competent man to head this Division. An excellent opportunity for a man who wants to get ahead in his field. Send resume of qualifications, experience, and salary expected. Reply Box 20455, Modern Plastics.

ENGINEER—1953 or later M.E or ChE graduate. Some experience with equipment for extrusion of thermoplastics desirable, but growth possibilities for young, promising engineer with a liking for research more interesting to us than experience. Aggressive, well established company located near New York City. Send resume including personal and experience data with salary requirements for prompt consideration. Reply Box 20655, Modern Plastics.

PRODUCT MANAGER
POLYETHYLENE SALES
To direct the polyethylene sales activities of a large company with sound basic position. Will have new Polyethylene production in early 1955. An exceptional opportunity for a man having background in Chemical Engineering and experience in plastic sales development. Location—New York City. Submit resume of training, experience and qualifications. Reply Box 21155, Modern Plastics.

MECHANICAL ENGINEER. An excellent opportunity for aggressive Mechanical Engineers with some knowledge of plastics is available in our expanding Southeastern United States plant. Experience in mold design, tube rolling equipment and allied equipment used in molding and laminating of plastics is required. Send complete resume and salary requirements to: C. B. Leape, Trafford Micarta, WESTINGHOUSE ELECTRIC CORPORATION, Trafford, Pennsylvania.

CHEMIST OR CHEMICAL ENGINEER: Midwest injection, compression, and transfer molder requires person for research and development work involving materials and products. Excellent opportunity for advancement. Send complete resume, salary expected, and recent photograph. Reply Box 20355, Modern Plastics.

(*Continued on page 264*)

Make Certain It's GENUINE

IMS Silicone Spray MOLD RELEASE

It Isn't Size—It's Quality That Counts!

EXCLUSIVE ALL-METAL
FAST-ACTING SPRAY HEAD
ENDS FUMBLING,
SPEEDS APPLICATION,
SAVES CYCLE TIME!

DELIVERED PRICES

Single Can	$2.00
Unbroken Dozen	$18.00
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Lower prices on larger orders shipped on your schedule as needed.

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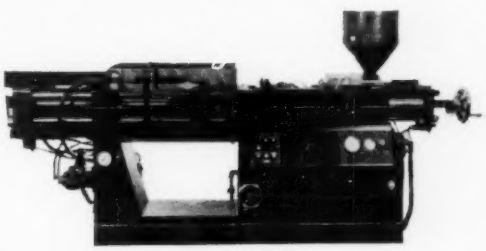

This is a high speed injection molding machine for automatic, single cycle or manual operation. Features low pressure closing, adjustable clamp stroke and cushion—both ends. All parts easily accessible for operation and maintenance.
Write for complete information.

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BSME or equivalent with a minimum of 2 years experience in one of the following:

- Metallic Sandwich (Stress Background)
- Sealants (Fuel & Pressure Applications)

to assist in material and process specification preparation, design applications and development, and testing of materials.

Write or apply

Engineering Personnel Office
Dept. P
North American Aviation
Columbus 16, Ohio

CLASSIFIED ADVERTISING

(Continued from page 262)

CONSULTANT (Vinyl Polymers) Well established alkyd resin manufacturer wishes to expand into polyvinyl acetate emulsion field. Wants experienced chemist with production background as consultant. Location upper New York State. All replies held in strict confidence. Submit complete information and fee desired. Reply Box 20755, Modern Plastics.

CHEMIST—Well established plastics extrusion company, located in metropolitan New York area, seeks young graduate chemist out of school a year or two for introduction into our research and development program on thermoplastics. High potentialities for growth more interesting than type and amount of experience. To receive prompt and careful consideration give full information regarding experience, education and salary requirements in first letter. Box 20555, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER with 3 to 7 years in Vinyl Polymer Development, Process Control, or Production Supervision. This position offers a challenge, good prospects, and security with an expanding firm, producing Plastic Resins, including Vinyl Monomer and Polymer, as well as other chemicals. Apply by mail to: NAUGATUCK CHEMICAL, Division U. S. Rubber Co., P.O. Box 460, Painesville, Ohio.

SALES ENGINEER—Well rated aggressive growing Chicago molder seeking experienced man who wants to expand his earnings. Capable of developing custom molding with ability handling industrial accounts. Real opportunity with unlimited territory. Permanent connection. Reply giving resume of qualifications and experience with desired drawing and commission arrangement. All inquiries confidential. POLYMOLD PLASTICS, INC., 3417 N. Western Ave., Chicago 18, Illinois.

DEVELOPMENT ENGINEER
Old established Midwest firm desires experimental and development engineer in the fields of elastomers, adhesives, bonding problems, filiform plastics, fibers, wire, and metal forming. Applicant should be between 30 and 45, preferably a good chemical background and desire to make a permanent location. Reply Box 23955, Modern Plastics.

SUPERVISOR-CHEMIST—thoroughly experienced treating with melamine and phenolic resins for decorative laminates to take full charge of large treating department. Excellent salary, bonus, rapid promotion with expanding Eastern manufacturer. Send resume. Reply Box 23055, Modern Plastics.

PLASTICS PRODUCT development engineer with experience in plastics molding for investigation of new products for established company with plans for expansion. Work would include market studies. Would also include investigation of plastics applications in company's present products. Salary open. Connecticut location. Reply Box 22555, Modern Plastics.

CHEMIST, PLASTISOL—with some experience in plastisol formulating for dipping, molding and slush casting applications. Should be capable of doing independent work. Excellent opportunity with growing plastisol manufacturer located in Chicago. Salary commensurate with experience. Our employees are advised of this advertisement. Reply Box 21255, Modern Plastics.

SALES TRAINEE: A Connecticut firm wants a recent male college graduate between 23-28 years of age who has completed his military duty to train for a sales engineering position in the field. Prefer one with technical background and sales ability. If interested, please contact Milton Yeoman, Personnel Director, ROGERS CORPORATION, Rogers, Connecticut.

TOOL DESIGNER
With 10 to 15 years experience on plastic injection or die casting molds. Knowledge of injection molding equipment desired. Excellent opportunity with well established proprietary molder in Greater New York area. Position open as result of retirement. Please furnish complete resume and state salary desired. Reply Box 24255, Modern Plastics.

FINISHING SUPERVISOR: Experienced, to take full charge of vacuum coating of molded plastic items. Knowledge of masking, lacquers, and other second surface operations essential. Supervisory experience and ability to train people required. Leading Midwest custom molder in desirable small community. All replies in strict confidence. Give previous experience and salary requirements. Reply Box 21055, Modern Plastics.

DEVELOPMENT ENGINEER—Molded Plastics: Openings with excellent opportunities are available for engineers with imagination and ambitions in the fields of polyester plate and molded products in an expanding organization. Previous experience necessary. Location Southeastern United States. Send complete resume and salary expectations to: C. B. Leape, Trafford Micarta, WESTINGHOUSE ELECTRIC CORPORATION, Trafford, Pennsylvania.

POSITIONS FOR PLASTICS EXECUTIVES $5,000-$50,000. One of the nation's largest executive agencies presents an exclusive service for men in the plastics and allied industries. This is a confidential, professional and rapid service for the nationwide placement of successful men under 45 in the engineering, technical, sales and administrative fields. Send a short resume including age, education and work history and we will tell you by return mail what we have available for you and how we can help. Write to H. Graebner at GRAEBNER'S EXECUTIVE EXCHANGE, 116 South Michigan, Suite 705, Chicago 3, Illinois. We also offer a special service to companies seeking qualified applicants in any field. Write for more information.

SITUATIONS WANTED

VINYL COMPOUND SPECIALIST—B.S., Age 34, 12 years experience in formulation evaluation and competitive analysis in all phases of vinyl compounding. Dry blends and conventional extrusion compounds, plastisols, surface coatings, adhesives, sealers. Equally competent in production and development. Will consider sales. Reply Box 24055, Modern Plastics.

WHARTON SCHOOL GRADUATE, accounting major, Air Force Officer in Government procurement for 2½ years, 26 years old, desirous of working hard to establish a career in the plastics field. Can begin in accounting, production or other similar administration job combined with some sales work. Prefer Philadelphia, Camden, N. J., or New York City area. Reply Box 23155, Modern Plastics.

SALESMAN—INDUSTRIAL MOLDING. Specialist in thermoplastics: nylon, Kralastic, hi-impact materials. Experienced in industrial molding, engineering, sales engineering, estimating, sales literature, customer service, materials application. Accustomed to discussing engineering problems with top personnel. Wish to represent and/or sell in Northeast for experienced custom molder of industrial parts (especially nylon). Commission, salary, expenses or combination. Reply Box 23555, Modern Plastics.

SALES AGENT with broad experience in the industrial area of the Midwest wishes to represent equipment manufacturers and suppliers in the Greater Chicago territory. Has worked closely with superintendents and plant engineers of most large accounts as well as with jobbers. Have modern well located office in new building. Reply Box 23855, Modern Plastics.

MANUFACTURERS' REPRESENTATIVE. Covering territory of Ohio, Indiana, and Kentucky for a top leader in injection molded products desires companion line of competitively priced compression molded plastics. Excellent coverage in electronic and appliance field. Cincinnati resident. Reply Box 24755, Modern Plastics.

MANUFACTURERS' AGENT, Southern Ohio and Indiana with successful plastic sales experience desires new connection with Midwest molder on commission basis only. Can offer wide experience in plastic sales with thorough knowledge of area's present and future customers. Interested only in Midwest firm. Reply Box 24955, Modern Plastics.

SALES AGENTS WANTED

WANTED—SALES REPRESENTATIVE: Progressive and established plastic manufacturer of vacuum formed 3-D plastic signs and industrial parts. Printing on plastic. Heat sealed items. Straight commission. Write ACME LAMINATING & PLASTICS COMPANY, 1315 E. Eight Mile Road, Hazel Park, Michigan.

MANUFACTURERS REPRESENTATIVES to sell custom molded compression and injection plastic parts in several open territories including New England, New York and eastern Pennsylvania, Chicago and Mid-West area. Must be experienced with Engineering background preferred. Commission arrangement with established molder located in western Pennsylvania. We are interested particularly in men calling on industrial accounts. Reply Box 22155, Modern Plastics.

SALESMEN or MANUFACTURERS' AGENTS, in all territories, on commission basis by modern completely equipped molder specializing exclusively in all forms of Fluoro-carbon plastics, including impregnations with fiberglass, asbestos, iron, etc. Methods are available to mold most pieces which previously have been machined. Reply in confidence. FLUORO PLASTICS, INC., 4546 Baker Street, Phila. 27, Penna.

SALES REPRESENTATIVE wanted by custom compression and plunger transfer molding company. We are interested only in men of proven ability who are now calling on industrial accounts. Modern plant located in Mid-West with modern and up to date facilities. Desirable territories open—commission basis. Reply giving experience, present lines, and territory wanted to Box 21455, Modern Plastics.

MISCELLANEOUS

INTERESTED IN PURCHASING: Dimethyl Phthalate, Diethyl Phthalate, Tricresyl Phthalate, Ortho-Nitrobiphenyl, Ethox Methox, Di Carbitol, Pycal 94. PEERLESS CHEMICAL CORP., 181 Greene Street, N.Y.C. 12.

REINFORCED PLASTICS SERVICES to foreign countries. Experienced American Engineering and Manufacturing consulting services available to firms starting or expanding fiberglass reinforced plastics fabrication. Complete information supplied including product design, material and process specifications, equipment and tooling requirements, molding techniques from hand layup to matched die methods, finishing and quality control. Reply Box 23355, Modern Plastics.

WANTED: One piece moulded stock box and cover with or without hinges. Size 4½x4x7. Send prices and samples to SPECIAL CHEMICALS CORP., 100 South Water St., Ossining, N. Y.

FOR SALE: Complete plastic wall tile and trim business including beautifully complete high-production tooling for eight and sixteen ounce machines, raw material and finished goods inventory. Established distribution. This is the most beautiful line offered today. Requires capital low six figures. Company concentrating in other lines. Reply Box 22655, Modern Plastics.

FIBERGLASS REINFORCED PLASTICS. Engineer-Designer and Production Manager Team seek new connection. Extensive experience in design and fabrication of commercial and military products of fiberglass reinforced plastics. Have organized and operated complete reinforced plastics engineering and manufacturing facilities including related functions of process and development laboratory, plaster, wood and plastic tool shop. Interested in new venture or established firm. Reply Box 23455, Modern Plastics.

POLYMERIZATION, FORMULATION, Product Development—have you a problem? Chemical expert with fifteen years of accomplishment in plastics, polymers, coatings, adhesives, laminates and fibers will make know-how available to you on project or retainer basis. Located in New York area; can travel. Reply Box 23655, Modern Plastics.

SALES ORGANIZATION located in Pennsylvania seeks selling connection on a commission basis with manufacturers of plastic products for home remodeling or modernizing. Reply Box 22855, Modern Plastics.

SALES AGENT—Outstanding sales personality interested arrangement with reputable Plastic Concerns, for manufacturers and wholesalers. Has own New York City office, and travels extensively. Reply Box 21355, Modern Plastics.

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Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.

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If you mold phenolics competitively, you should be using DURITE GP-102. Let us send a technical representative to demonstrate the advantages of this molding powder in your plant or, if you prefer, we will send you a sample. The Borden Company, Chemical Division, DURITE Products Department MP-25, 5000 Summerdale Avenue, Philadelphia 24, Pennsylvania.

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Phenolic Molding Compounds • Abrasive and Frictional Bonding • Resins • Molding and Specialty Resins • Lamp Basing Cements

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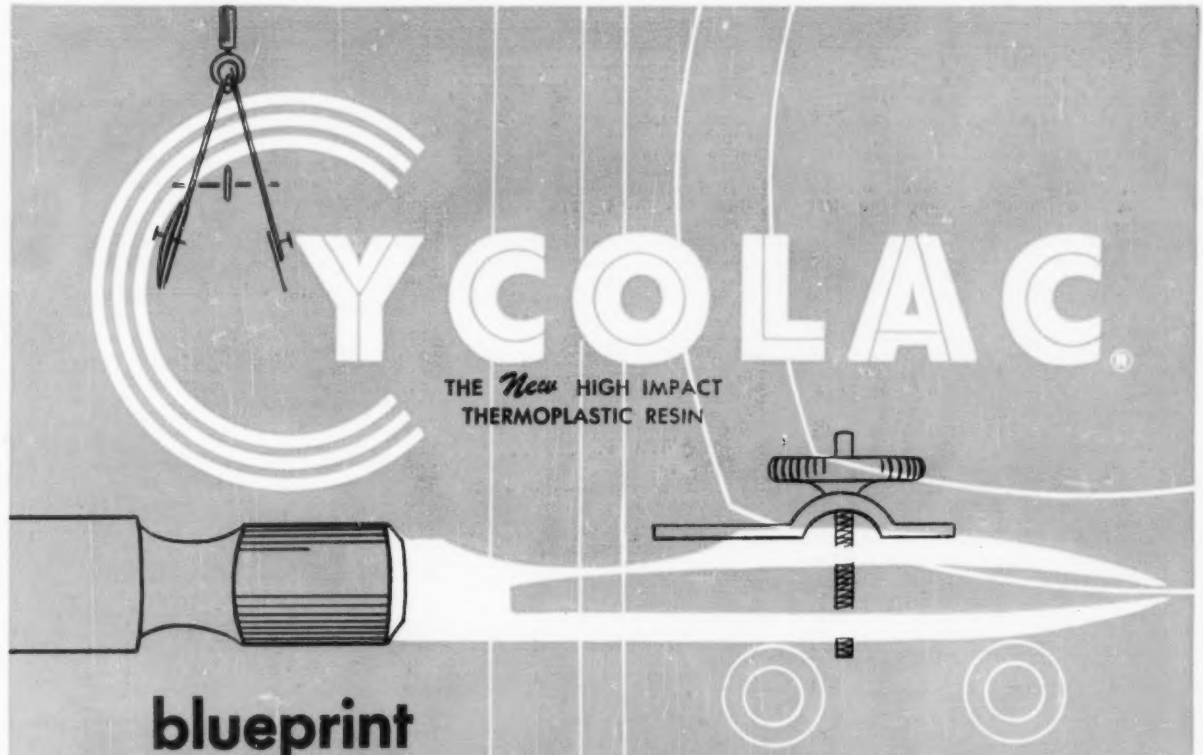

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CORPORATION
King Philip Rd., East Providence, R. I.

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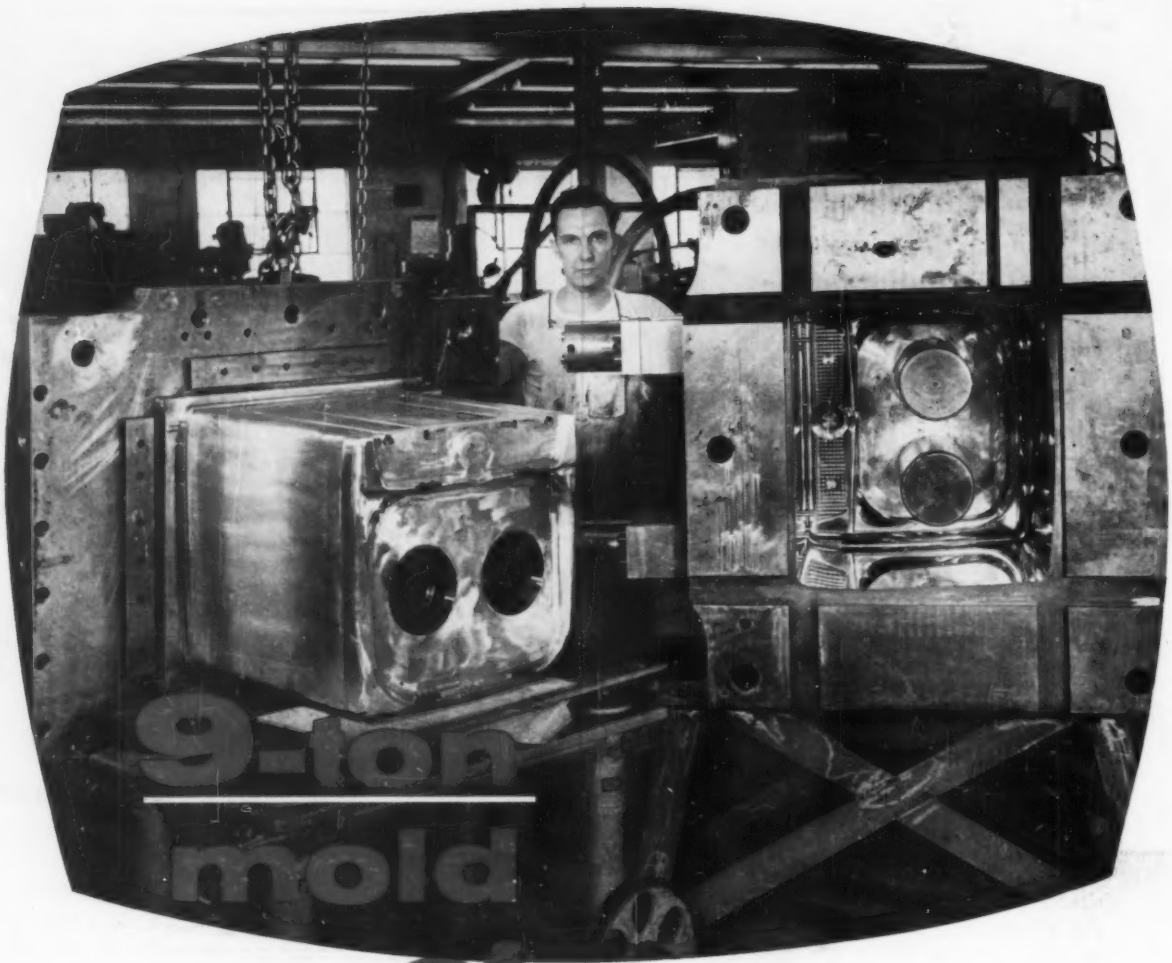
molded Fiberglass company

WORLD'S LARGEST MANUFACTURER OF CUSTOM MOLDED FIBERGLASS PRODUCTS
Ashtabula, Ohio



of

CRUCIBLE CSM 2 FORMS 21" MOTOROLA TV CABINET . . .

When Chicago Molded Products Company was asked to build a mold for Motorola's 21" TV cabinet, they chose Crucible CSM 2 mold steel for the job. The choice was determined not only on CMPC's long and successful experience with CSM 2, but also by Crucible's experience in producing the large tool steel forgings required.

To produce the cavity section alone, required what was probably the largest mold forging yet made. Crucible cast a 25,000 pound ingot which, after upsetting, cropping, forging and planing, was reduced to a final weight of 13,960 pounds. The plunger and face plate sections were made from separate forgings.

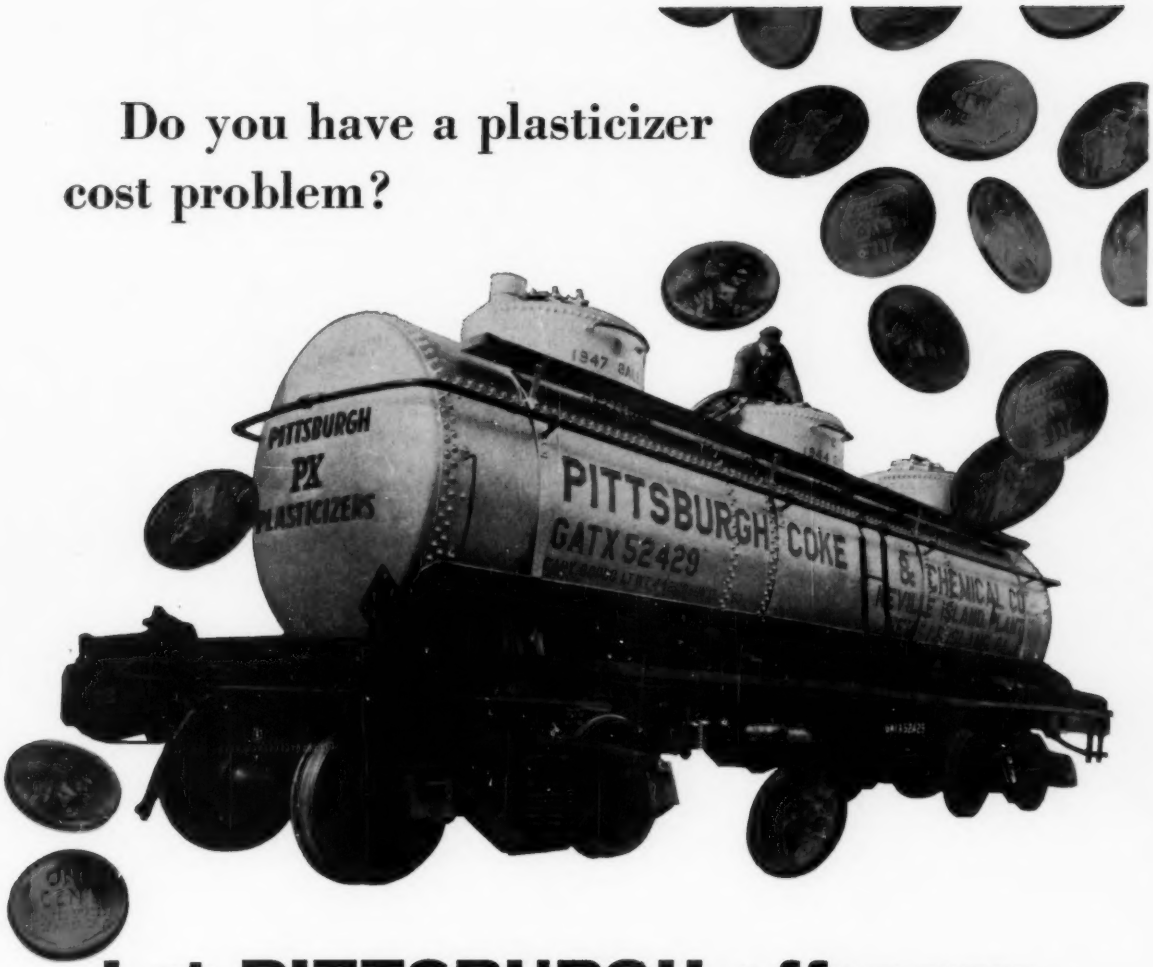
This is just one of thousands of applications where Crucible CSM 2 has proved its quality and dependability . . . that's because all our mold steels are actually quality tool steels. Next time you need mold steels — call Crucible.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **MOLD STEELS**

CRUCIBLE STEEL COMPANY OF AMERICA · TOOL STEEL SALES · SYRACUSE, N. Y.

Do you have a plasticizer cost problem?



Let PITTSBURGH offer you some Real Savings

HERE'S a new Pittsburgh development to help you reduce plasticizer costs without sacrificing plasticizer quality. Pittsburgh now offers you a blend of one-third Pittsburgh PX-114 (Decyl Butyl Phthalate) and two-thirds Pittsburgh PX-118 (IsoOctyl Decyl Phthalate). This blend provides almost exactly the same desirable properties as DOP—but at appreciably lower cost.

Pittsburgh Coke & Chemical has developed a number of these blends as a part of its continuing effort to provide you with better plasticizers at lower cost. We'll gladly help you explore the possibility of using blends to improve quality and reduce costs in production at your plant. If such savings are possible, we'll blend to your specifications in tank truck or tank car quantities.

Let's tackle *your* plasticizer cost problems. Call or write us *today!*

LOOK AT THIS PROPERTY COMPARISON

Property comparison below is based on 100 parts resin, 54 parts plasticizer and 3 parts stabilizer in each formulation.

	DOP	⅓-114 ⅔-118
Modulus (100%)	1600	1670
Shore Hardness (10 Sec.)	78	80
Clash-Berg, Tf, oC.	—26°C	—25°C
A. C. Volatility (24 hrs./90°C)	5.0	5.0
Oil Extraction (7 days/25°C)	1.4	1.5
Gasoline Extraction (1 hr./25°C)	14.3%	12.0%
Silicic Acid Test (24 hrs./60°C)	4.5	4.4
Tensile Strength	3100	3050
Ultimate Elongation	370	380

PLASTICIZER DIVISION
PITTSBURGH
COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

W&D 5494

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How to make a good product even better (at lower cost, too) with plastics parts by G.E.

BEFORE:
Die-Casting

AFTER:
Low-Cost Plastics

Here is a typical problem handled by G-E Plastics Engineers—a metal cooling fan used in an induction motor. Cost of metal was high and machining operations were substantial. With a wealth of experience in designing plastics products for moving liquids and gases, G-E Plastics Engineers suggested molding this unit from rag-filled phenolic material. Result: A new and more efficient part which eliminated machining and greatly reduced the cost of the finished product.

Are you a manufacturer of high-volume parts or products?
If you are, it is very likely that General Electric's experience in applying molded plastics can make a technological contribution that can cut your costs or improve your design. We'd like to discuss your particular problem with you.

Write: Plastics Department, General Electric Company, Pittsfield, Mass.
Plants at Decatur, Illinois—Taunton, Massachusetts 1450-8A

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